Volume 25 FEBRUARY, 1919 Number 6

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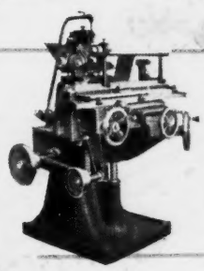

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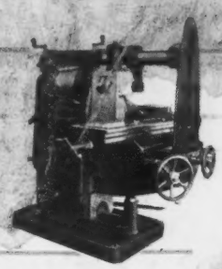

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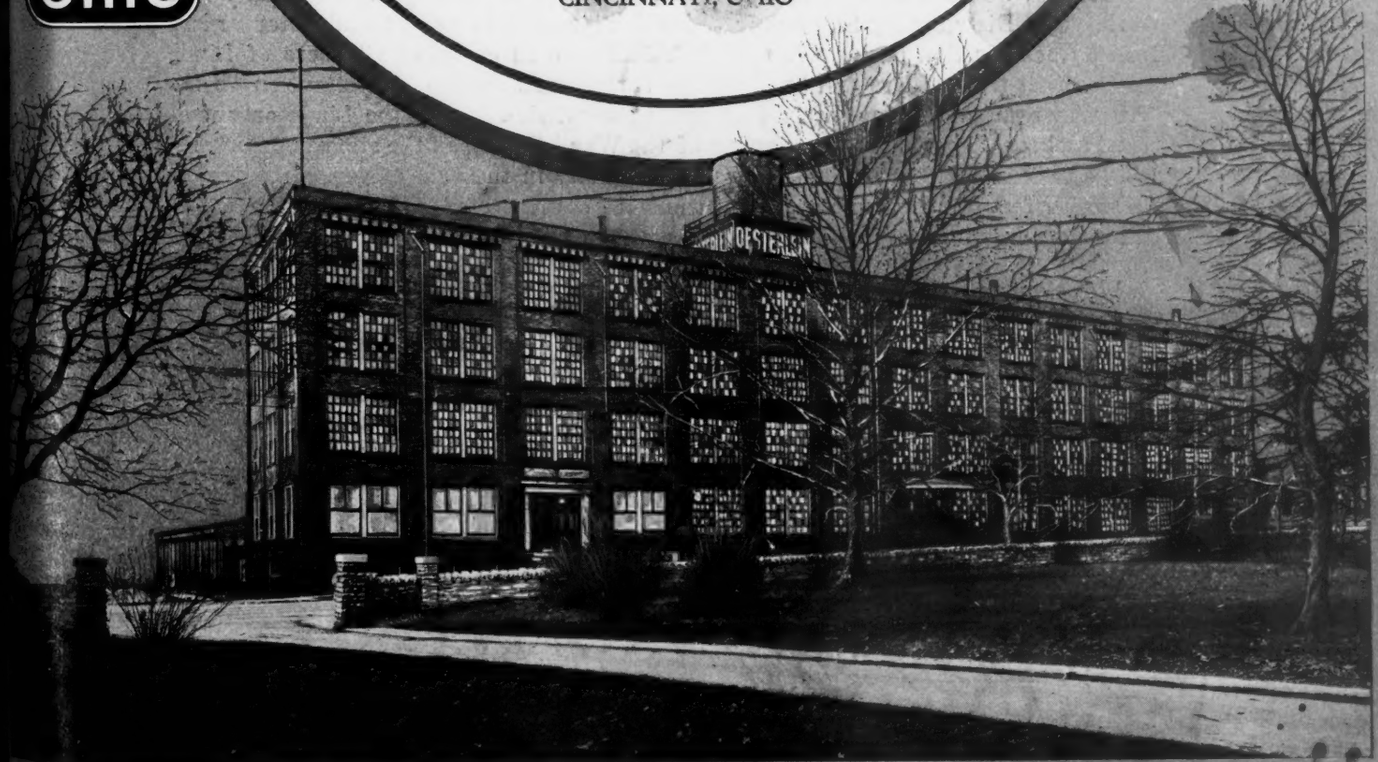

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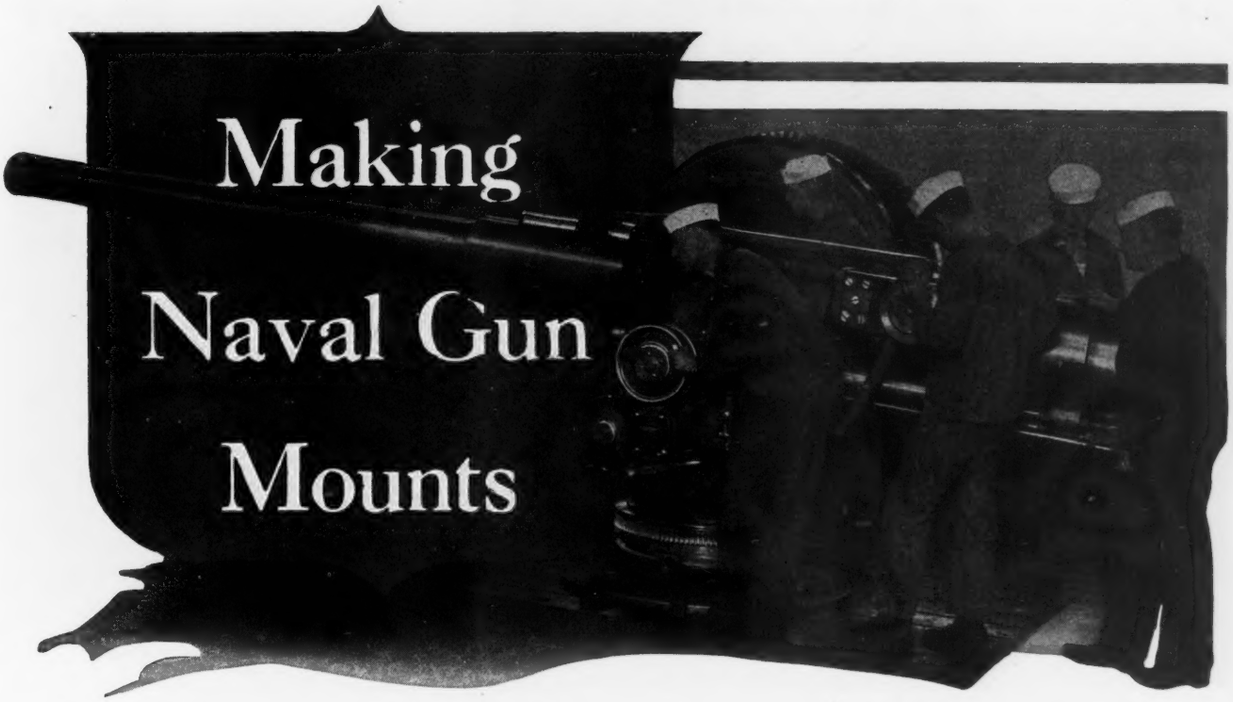
FEBRUARY MACHINERY 1919

Making Naval Gun Mounts



First of Two Articles Describing Special Tools, Gages and Fixtures Used at the Plant of the Mead-Morrison Mfg Co., Where 1000 Complete Mounts for 4-inch Guns are Being Constructed for the United States Navy

BY FRANKLIN D. JONES

THE high-power guns used in modern warfare, which are capable of hurling heavy projectiles long distances with mathematical precision and accuracy, have been classed as one of man's greatest mechanical achievements. While some forms of mechanism are more wonderful in their complication and more intricate in their mechanical action, the design and construction of naval, coast-defence, and other heavy guns involves so much scientific knowledge, precision and skill that ordnance of this class certainly ranks high among achievements of a technical or mechanical nature. The problems which confront the designers of these guns are naturally very complex and center about such factors as extreme pressures and the design of parts which must withstand them, the features affecting the flight of the projectile, the mechanical means for taking the recoil at the instant of firing, and the training of the gun upon the target. The constructor of such ordnance is not bothered by the intricate calculations of ballistics, but, nevertheless, he too has difficult problems which, if boiled down and stripped of detail, may be summed up under the single word "accuracy." The inaccurate gun within limits may have the same destructive power as one of perfect construction, but it is, of course, worthless if the destructive force cannot be properly directed and controlled.

The essential general features of guns of the class referred to are first the gun or rifle itself, and second the mounting, which includes the mechanism for adjusting or training the gun, the recoil device, and the sighting mechanism. As just intimated, the mounting serves several distinct and important purposes. It supports the gun, enables it to be adjusted in both horizontal and vertical planes, is equipped with a recoil mechanism which gradually arrests the backward lunge of the gun as the projectile leaves it, and has, in addition, some form of adjustable sighting mechanism, which is utilized to set the gun for any given range, and also to determine its position relative to the target. It is evident, then, that the mounting is quite as important as the gun itself, and that its value depends largely upon the accuracy of construction. It is essential to so construct the movable parts of the gun mounts that there is free movement throughout the entire range of motion, but without perceptible play between the fitted or meshing parts. While lost motion or play is undesirable in many other classes of mechanical equipment, it is particularly objectionable in a gun mount, because even very slight errors in the adjustment of the gun or sighting mechanism are greatly multiplied, especially when firing at a range of several miles.

Because of the fact that all naval ships carry a number of spare parts for repairs, extreme accuracy is required, and hence the necessity of absolute interchangeability. The manufacture of gun mounts requires many special jigs, fixtures, tools, and gages

The demand of the Government during the past year for the rapid production of various classes of munitions and ordnance in large quantities has resulted in the development of many new and improved appliances designed to increase the output and insure the high degree of accuracy required for work of this kind. While this article deals with the making of naval gun mounts, its practical value to tool designers and others interested in manufacturing methods is due to the fact that many of the ingenious special fixtures and tools which are described and illustrated may be applied, in principle, at least, to the manufacture of various other forms of mechanism. It is worthy of note that the Bureau of Ordnance of the Navy Department has selected the Mead-Morrison Mfg. Co.'s jig and tool equipment as the best and most efficient of any that has been designed for making the 4-inch gun mounts.

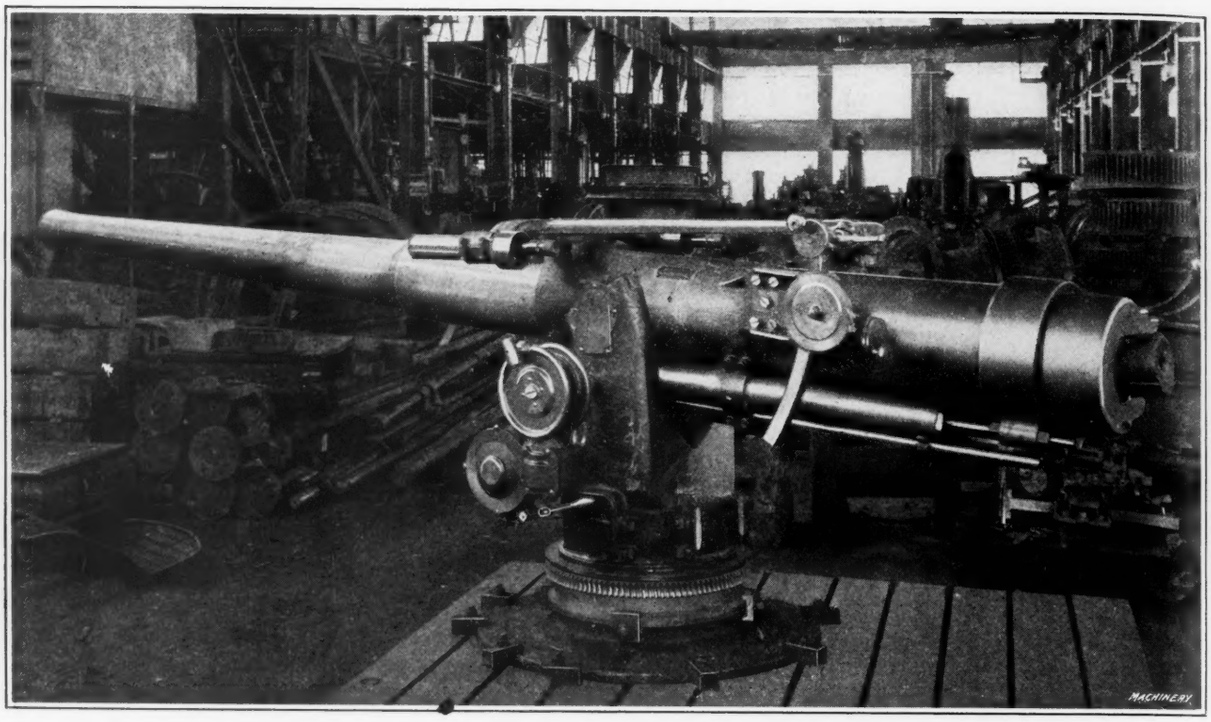


Fig. 1. Gun Mount and Gun assembled to test Operation of the Adjusting Mechanism and Action of the Counter-recoil Plunger

such as will be found illustrated in this and a succeeding article dealing with the highly developed manufacturing practice at the plant of the Mead-Morrison Mfg. Co., East Boston, Mass. This company is now building 1000 mounts for 4-inch naval guns of the class used on some of the destroyers, and many unusual and interesting special tools and fixtures have been designed and built to meet the exacting needs of this work. Before proceeding further, acknowledgment should be made of our indebtedness to the management of the Mead-Morrison Mfg. Co., and especially to the works manager, J. T. MacMurray, and to the superintendent of the Ordnance Department, Alfred Spangenberg, under whose direction most of the special tools and fixtures were designed. The cooperation of the naval representative, Lieutenant W. A. Needham, is also greatly appreciated.

As it is not feasible to describe all of the special equipment used in the manufacture of these gun mounts, nor all the successive operations on the different parts, the more unusual ones have been selected. It is believed that they embody many valuable principles of tool and fixture design that may, with some modification as to arrangement and detail, be applied in other lines of manufacturing.

Principal Parts of the Gun Mount

The gun mount is composed of four main parts known, respectively, as the stand, carriage, slide, and sight. The stand or baseplate supports the carriage, (see Fig. 1) which, in turn, has bearings at the top for receiving the trunnions on the slide. The slide forms a bearing for the gun proper, the gun moving longitudinally in the slide as it lunges backward and then forward again after firing. The slide also supports the recoil cylinders. The elevation of the gun in a vertical plane is obtained by turning the slide about its trunnions, whereas movements in a horizontal plane are secured by turning the carriage upon its stand or base. The mount is provided with suitable gearing for the transmission of these vertical and horizontal motions. In the case of a 4-inch gun, the movements are effected by turning small handwheels located on the starboard and port sides of the gun mount. These hand adjustments require little physical effort, as the gun is so located in the mount as to be in perfect balance, and the gearing is also made very accurately and works smoothly, without any perceptible backlash or play. The adjustable member of the sighting mechanism is pivoted to the top of the slide and consists of a yoke which supports a telescope on each side of the gun, and is attached to a graduated segment-shaped sight- or sword-bar for elevating the gun according to the range. The yoke is adjustable in two directions, vertically and horizontally.

The operations to be described are confined principally to the main parts referred to, since many of the most ingenious fixtures and tools are required for machining these parts within the required limits of accuracy.

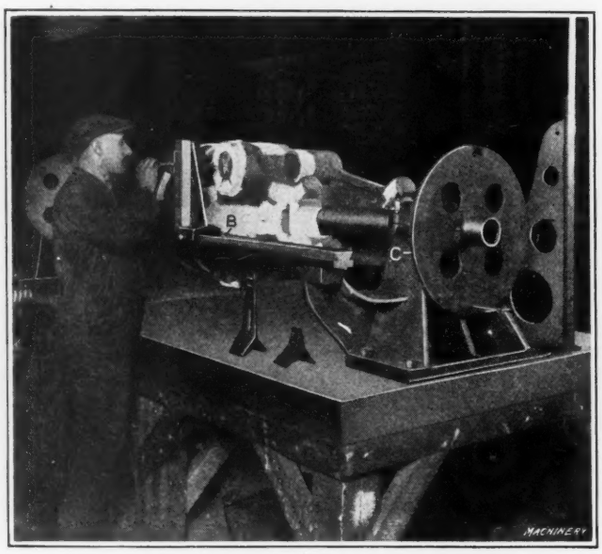


Fig. 2. Special Fixture used for laying out Carriage Castings

Lay-out Fixtures for Large Castings

The steel castings for the carriage, stand, slide, and sight are carefully laid out before machining, not only to insure that all surfaces will true up, but also to secure a more uniform distribution of the stock between different pads or other surfaces which must be finished. While it would be possible to design fixtures that would eliminate the preliminary laying-out operation, these lay-out lines are transferred to the work so easily and accurately by the comparatively simple laying-out fixtures used that this method is considered preferable to the use of holding

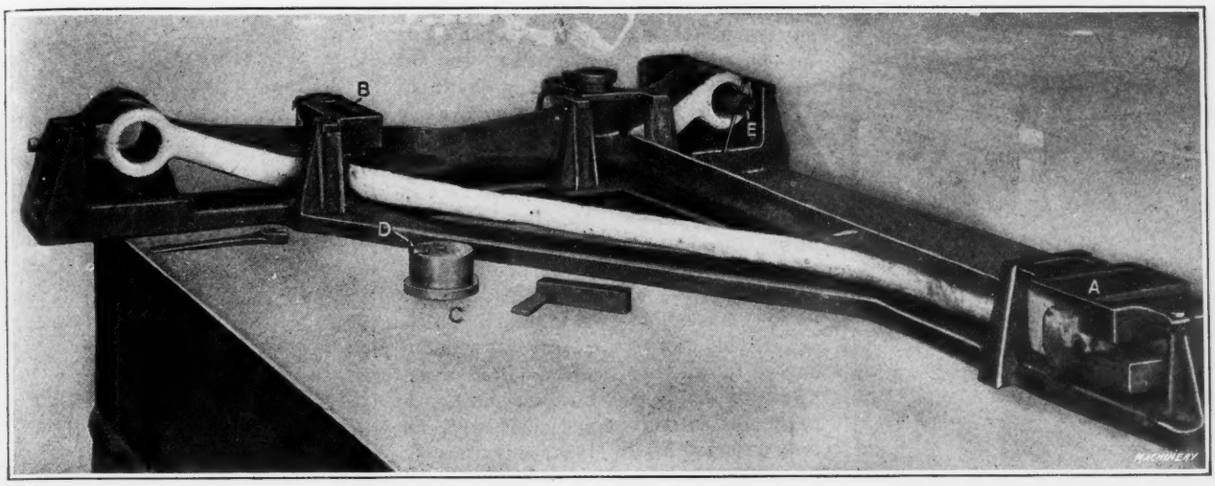


Fig. 3. Laying-out Fixture for Yoke of Sight Mechanism

fixtures designed to locate the casting in the correct positions by means of stops or locating points that bear against the rough surfaces of the casting. Since there are many bosses, holes, and other surfaces which require machining, the accurately located lay-out lines insure that the relation between the machined and unfinished surfaces of each part will be in accordance with the government drawings, thus avoiding the removal of too much metal in one place and too little in another, as well as the unsightly appearance of work finished in this way, and extra chipping and fitting at points where surfaces may be cut down below the main surface of the casting.

The laying-out fixture used for the carriage casting may be seen in Fig. 2, which also shows a casting in place in the fixture. The casting is held in a horizontal position on a shaft provided with a spider and jack-screws which engage the interior surfaces. The lines are drawn by a scriber point *A*, carried by a holder that is free to slide horizontally along a guide-bar *B*. The guide-bar is marked at different places for locating the scriber block horizontally in as many positions as may be required. The scriber can also be adjusted vertically by means of a slide. The guide-bar *B* has a longitudinal adjustment derived from a screw at one end, so that it can be set in the correct position relative to the casting when the fixture is first used; afterward, this adjustment is not required. The main work-holding spindle is provided at one end with an index-plate *C* containing four holes located 90 degrees apart, and one intermediate hole representing a 45-degree position. Any of these holes may be used for locating the casting in different positions. The five positions on the index-plate correspond to the relation between the different surfaces which must be laid out on the side of a casting. In other words, the surfaces are located in planes 90 degrees apart with intermediate surfaces in a 45-degree position. Horizontal lines may be drawn upon the casting by simply traversing the scriber holder along the guide-bars, or vertical lines may be drawn by moving the scriber slide up or down. When lines are required around a circular part, the scriber point is simply held against the casting after it is set in the correct position by a graduation line on bar *B*, and then the entire casting and the main spindle of the fixture are revolved, while the scriber is held in contact with the work. By means of this simple fixture, the castings are laid out accurately, and in a relatively short time. The same general type of fixture is used for laying out the slide casting.

A different type of laying-out fixture is illustrated in Fig. 3. The part to be laid out in this case is the yoke, which forms part of the sight mechanism. This yoke is shown in place, and lines are scribed on it by means of templets at *A* and *B*, and also by scriber bushings and scriber arbors. The templets have openings conforming to the position of the lay-out lines drawn with an ordinary scriber. These templets are hinged so that they can be swung out of the way to permit inserting or removing the yoke. One of the bushing scribers used for drawing a circle is shown on the laying-out table at *C*. This bushing is inserted through a close-fitting hole in the laying-out fixture, and at one side there is a projecting point *D* which scribes the circle concentric with the hole in the fixture as the bushing is revolved. At *E* is shown a scriber arbor which passes through a hole in the fixture and draws a circular line upon the work as it is revolved in its bearing.

Another form of laying-out tool which reduces the time required for this work is shown in Fig. 4. This is practically a multiple scriber having seven scriber points which are so located vertically and horizontally that they draw the lines on the circular parts of the stand as the scribing tool is

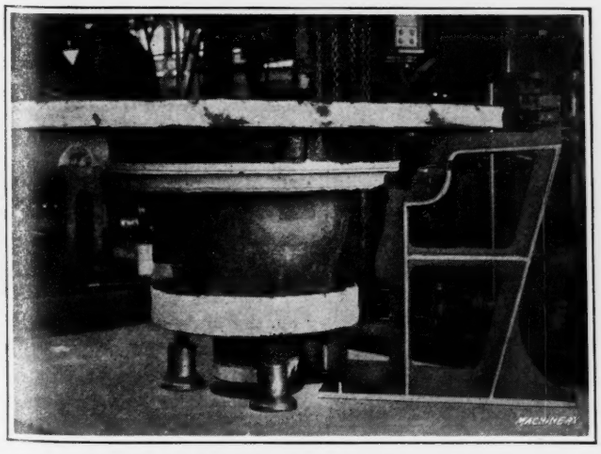


Fig. 4. Multiple Scribing Tool having Seven Scriber Points

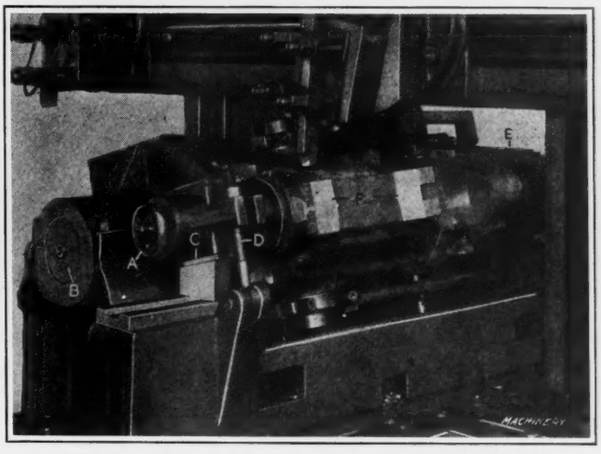


Fig. 5. Fixture for planing Angular Surfaces on Slide Casting

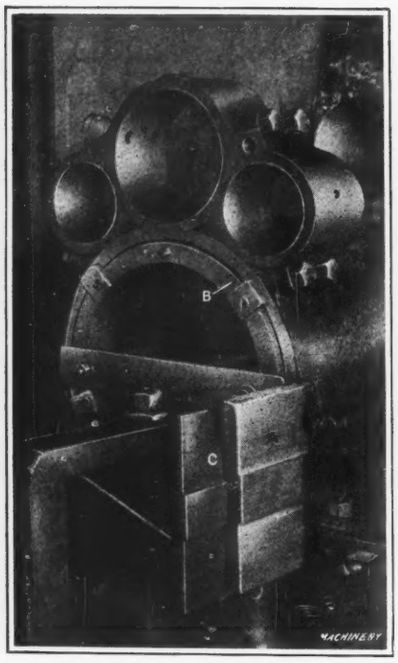


Fig. 6. Planer Tool-setting Gage for Slide Casting

pushed around the surface of the laying-out table.

Operations on the Slide

As the slide is the part which holds the gun in position, the axes of the trunnions on each side must intersect the axis of the slide and be exactly at right angles to it. The bore of the slide must also be truly cylindrical and have a keyway which is parallel to the axis. This keyway engages a rather wide key or tongue which is integral with the gun itself, and prevents any turning motion of the gun during the recoil and counter-recoil movements. To handle work of this kind successfully, it is essential to perform the successive operations in such an order that the work may be positively located for each operation with reference to some finished part which is naturally adapted for locating purposes. Such a surface is, in a sense, a base or foundation, since it is used in locating the work for each successive operation, the various other finished surfaces being located with reference to this base surface, instead of employing several locating points, with the resulting liability of greater accumulative error. In the case of the slide, the trunnions are used for locating purposes, and for this reason the turning of these trunnions is the first important operation on the slide. This work is done on a duplex machine which is practically a double lathe having a work-holding fixture mounted on a carriage which slides between the headstocks. Each lathe spindle is equipped with a turning tool which is in the form of a sleeve carrying two tools located on opposite sides and forming practically a hollow-mill. The trunnions which are, of course, integral with the cast-steel slide, are turned separately as the work-holding carriage is fed in first one direction and then the other.

Planing Operations on the Slide

The method of planing bosses or pads on the side of the slide is illustrated in Fig. 5. These plane surfaces are located at an angle to a vertical plane passing through the axis of the slide so that the casting must be held in an inclined position as the illustration shows. There are also similar surfaces on the opposite side of the slide so that the fixture is arranged for holding the casting in two positions. The slide is located in the fixture by the trunnions previously turned, and receives additional support from two conical plugs which enter the finish-bored recoil cylinder holes at each end, and are screwed in or out by handwheels, one of which is shown at *A*. The swinging part of the fixture which enables the work to be held in the two positions is carried by trunnions, one of which is shown at *B*. This swinging part is positively held in the required angular position by engagement with an inclined surface *C*, against which it is held by hinged tie-bolts *D*. On the opposite side of the fixture there are other surfaces corresponding to *C*, and when one side of the slide has been planed, the pivoted member of the fixture is simply swung over into engagement with the locating surfaces on the opposite side.

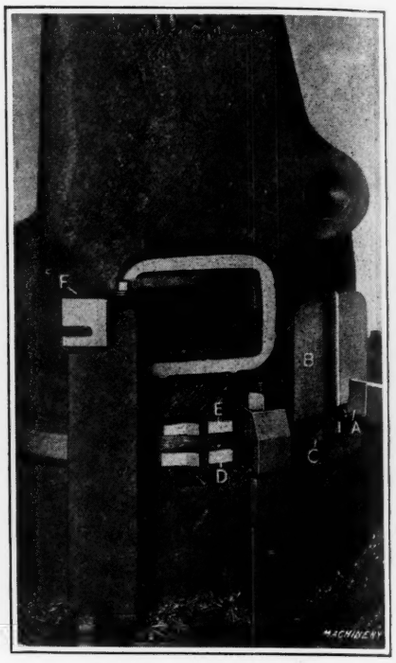


Fig. 7. Tool-setting Gages applied to Slotter Fixture

Positive Method of Setting Tools

The planer tools are not set by measurements for the operation shown in Fig. 5, but are positively located by bringing the cutting edge of the tool within 0.002 inch of hardened plates attached to one end of the fixture; one of these tool-locating plates is shown at *E*. The surfaces of this hardened plate are exactly 0.002 inch lower than the surfaces to be machined, so far as their location vertically is concerned. A 0.002-inch feeler or thickness gage is used to set the tools and also to check the finished surfaces by means of a straight edge. This positive method of setting cutting tools is not only employed on the planer, but also as far as possible in connection with other machining operations, in order to insure interchangeability, reduce the chance of error to a minimum, and eliminate the personal factor as far as this is practicable. The standard which is used in all gaging surfaces is 0.002 inch low.

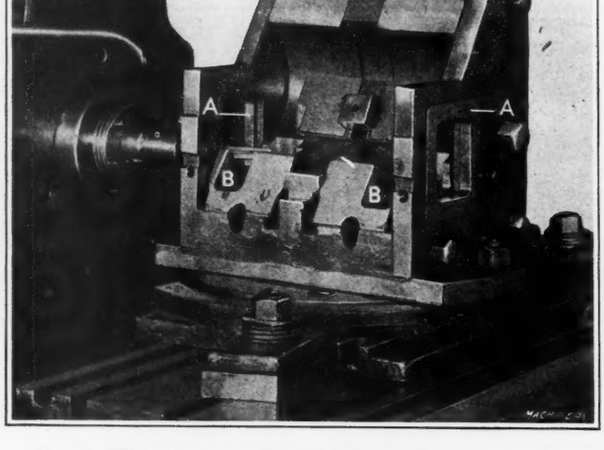


Fig. 8. Milling Fixture equipped with Guide Plate for controlling Path followed by Cutter

The planer illustrated in Fig. 5 is also used for planing the seat *F* of the slide which holds the segment gear for elevating or lowering the gun in a vertical plane. The fixture for planing these surfaces is located just in front of the fixture shown in this illustration, and the casting is held in a crosswise position relative to the planer table. The trunnions are again used for locating the casting, and the fixture has a plate bolted to it for setting the tool in the different positions required.

Another planing operation on the slide is illustrated by the detailed view, Fig. 6. The work in this case is planing the surface or seat *A*, against which the sight-bar bracket is held. The interesting part of this operation is the method

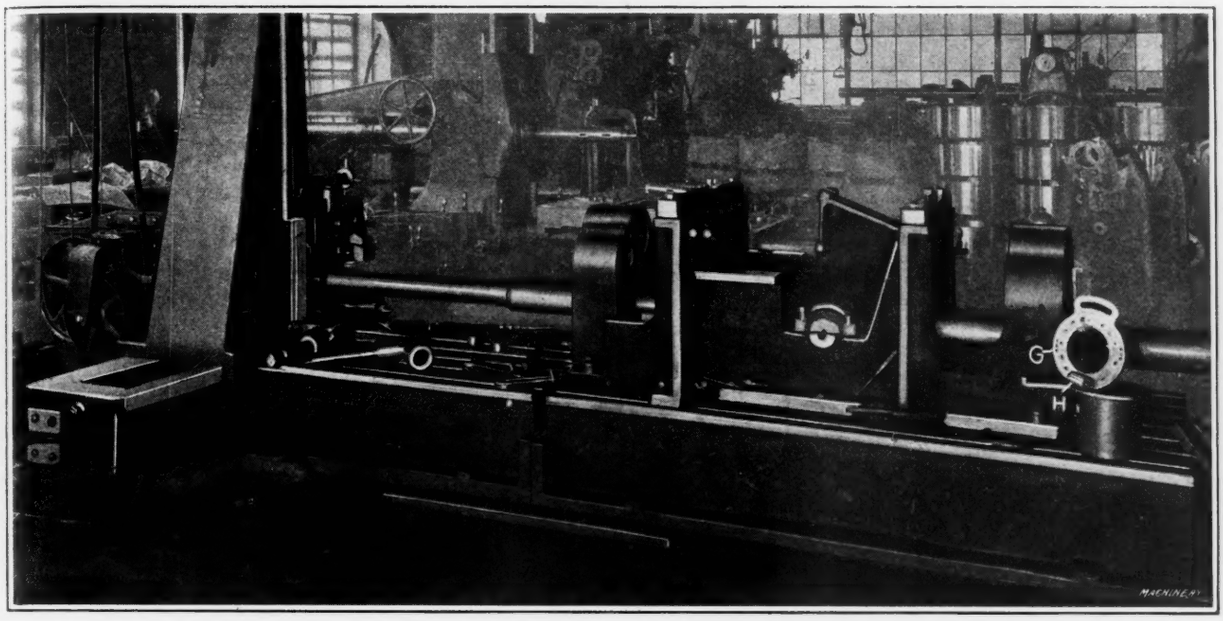


Fig. 9. Horizontal Floor-type Boring Machine provided with Special Mechanism for traversing Bar while planing a Keyway in Alignment with the Bore

of setting the tool. A positive tool-setting gage of the general type previously mentioned is employed. The sight-bar bracket seat has a tongue planed on it for locating the bracket and holding it in alignment, and it is essential to have this tongue located with reference to the bore of the slide. The body of the tool-setting gage is in the form of a ring *B* which is inserted in the bore. Attached to this ring there is an extension upon which is formed a vertical surface and tongue corresponding, in regard to location, to the finished seat *A* for the sight-bar bracket, so that the tool can be set by simply bringing it within 0.002 inch of the gage. The ring *B* of the gage is split, and is adjustable by means of a conical screw so that it fits tightly in the bore.

Another application of the positive method of setting cutting tools is shown by the detailed view, Fig. 7. The machine in this case is a slotter and the operations are on certain exterior surfaces of the carriage. The tool *A*, which is used for planing seat *B*, is set by the hardened plate *C* attached to the fixture. A similar plate *D* is used when planing surface *E*. This fixture also has four tool-setting gages similar to the one shown at *F*. After the tool is set, this gage is swung out of the way for performing the slotting operation.

Fig. 8 illustrates a positive method of controlling the path followed by a milling cutter. The operation is on the caps for the carriage trunnion bearings. Two of these caps—one right- and one left-hand—are mounted in the fixture at one time. When performing the operation shown in the illustration, the cutter is guided by a hardened plate *A* (see also opposite end of fixture) which comes into contact with the shank of the cutter. By keeping the cutter shank in contact with this plate the work is milled to the required form. The fixture is indexed half way around for performing a similar operation on the other cap. This same fixture is also used for milling the surfaces at *B*.

Drilling Fixture for the Slide

It is necessary to drill quite a number of holes in the slide, and these are located on different sides and at various angles to one another. For this reason a large indexing fixture of the design shown in Fig. 10 is employed. This particular illustration shows the cover *A* of the fixture removed in order to illustrate more clearly the position of the slide casting, which is located by the trunnions as in preceding cases. The main body of the fixture is also supported by heavy trunnions at each end, and the large disks *B* and *C* enable it to be held in different positions. These disks contain holes which are engaged by suitable indexing plungers *D* at each end of the fixture.

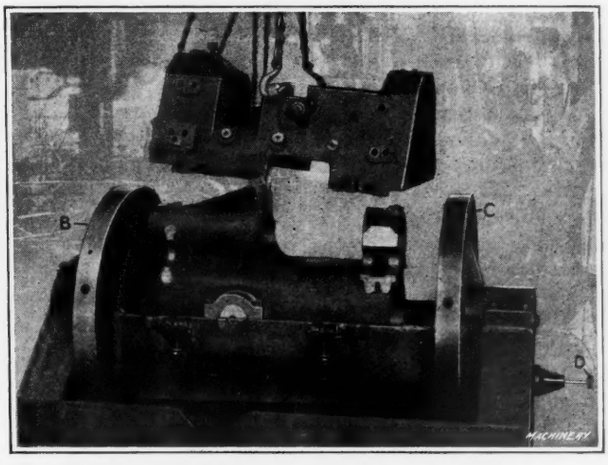


Fig. 10. Indexing Drill Jig for drilling the Slide

Use of a Combination Boring and Planing Machine

One of the more unusual operations on the slide is illustrated in Fig. 9, which shows a floor-type horizontal boring machine which, by means of a special attachment, may also be used for a planing operation. Before the slide is taken to this machine, a bronze liner is riveted into the main bore which forms the bearing for the gun when the latter is assembled. The illustration shows the bar in position for boring this liner. The same fixture is also used for boring the holes for the recoil and spring cylinders. The planing operation is for forming the keyway which engages the key on the gun as previously mentioned. This keyway must have its edges exactly parallel with the axis of the slide bore, and to insure accuracy of alignment, the idea was conceived of planing the keyway on the boring machine. This involved equipping the machine with some form of mechanism that would give the boring-bar a traversing movement. The mechanism employed may be seen at the left-hand end of the machine and is also shown by the front elevation and plan in Fig. 12. The arrangement for transmitting a traversing motion to the bar and of reversing its direction of movement at the end of the stroke is similar to a planer drive. The countershaft above drives the planing attachment by means of open and cross belts, which are alternately shifted onto the tight pulley below. The shaft carrying the pulleys has a pinion *A* at the end, which meshes with gear *B*, on the shaft of which is another pinion engaging directly with rack teeth on the boring mill spindle. A

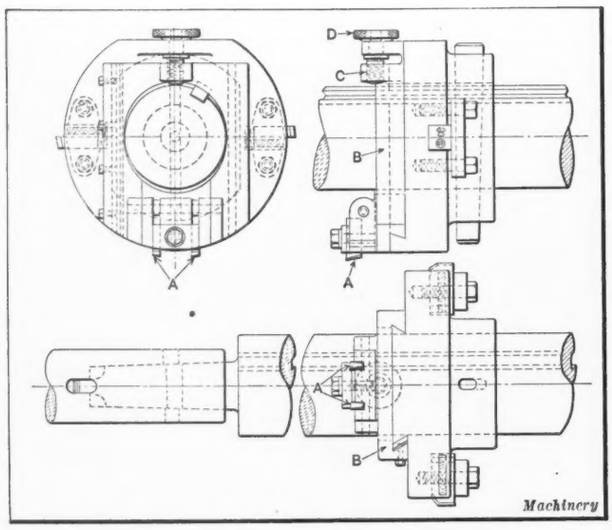


Fig. 11. Tool-Head used on Boring Machine while planing Keyway

bracket attached to the bar is connected with a slide *C*, which is traversed along the support *D*. This slide carries cams or dogs that engage a roller on reversing lever *E*, which, in turn, shifts the driving belts on pulleys *F*.

As the keyway is quite wide, it is formed by two separate operations. In the first place, a strip or narrow section of the liner, approximately equal in width to the width of the keyway, is cut out by means of two parting tools located the required distance apart. These two tools are shown at *A* in Fig. 11, which is a detailed view of the tool-head. The tools are carried by a pivoted block or apron which is free to swing outward on the return stroke, the same as the tool-block of a regular planer. The slide *B* carrying this tool-block is fed radially by a screw *C* which may be operated either by hand or automatically. The automatic feed is derived from a pawl which turns a ratchet located at *D* on the feed-screw when the pawl engages a stop at the end of the cutting stroke. After a section of the liner has been removed by the two tools, the latter are replaced by a single planing tool which is used for finishing the keyway.

As the bottom of this keyway is radial instead of flat, it is necessary to provide a circular feeding movement for the tool. This circular motion is derived from a splined bushing through which the bar passes, and a hand-operated screw connecting with the bushing. This bushing, which may be seen at *G* in Fig. 9, enters one end of the fixture and the bar passes through it. The small nut *H* which is free to swivel, engages a feed-screw, at the outer end of which is mounted a handwheel. As the boring-bar is traversed to and fro by the planing mechanism, the handwheel is turned after each cutting stroke, thus revolving the bushing and bar for feeding the tool for the next successive cut.

Routing the Oil-groove in the Slide Liner

The bronze liner of the slide requires a continuous oil-groove of varying pitch which is routed out on the horizontal boring machine illustrated in Fig. 14. The shape of this oil-groove is indicated by the grooves in the cylindrical cam at the right. A roller engages this cam groove and causes the bar to be traversed axially as it revolves. The small routing tool is driven directly by a ¼-horsepower motor which is mounted in a yoke carried by the boring-bar. A detailed view of this yoke and of the motor is shown in Fig. 13. The motor *A* is bolted to a slide *B* which can be moved in or out for feeding the tool by means of a hand-operated screw. The routing tool is driven direct by the armature shaft. The reduction in the rotary speed of the boring-bar for the routing operation is obtained by driving the bar through special reduction gearing. For the regular drive used when boring, motion is transmitted to the bar through a train of spur gearing, and when the oil-groove is to be routed the spur-gear drive is disconnected by shifting a clutch which throws into engagement a worm-gear drive, which greatly reduces the speed. The grooves in the cam are made continuous at the points where the grooves cross by means of removable blocks; thus when the engaging roller has passed an intersecting point, a different block is inserted to form a continuous groove for the roller when it is passing the same intersecting point while engaged with the other groove. As the rotation of the cam is very slow, the operator has plenty of time to make this change without having to stop the machine.

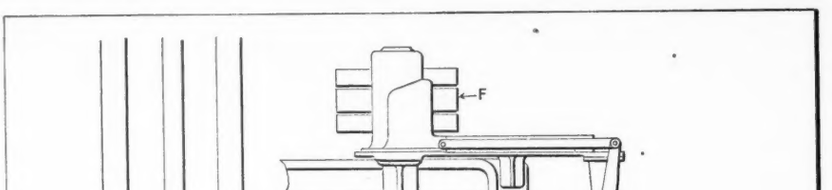


Fig. 12. Elevation and Plan of Boring Machine Planing Attachment

Duplex Fixture for Routing Oil-grooves

Bronze bushings are forced onto the trunnions of the slide, and these bushings must be provided with suitable oil-grooves. The duplex type of fixture used for routing these grooves before the bushings are forced onto the trunnions is shown in Fig. 16. The routing operation is performed on two bushings simultaneously, and a drilling machine is used for the

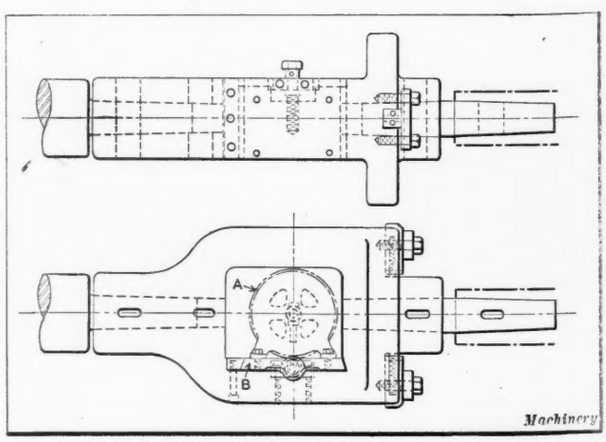


Fig. 13. Special Yoke and Slide for holding Motor which revolves the Routing Cutter used on the Machine shown in Fig. 14

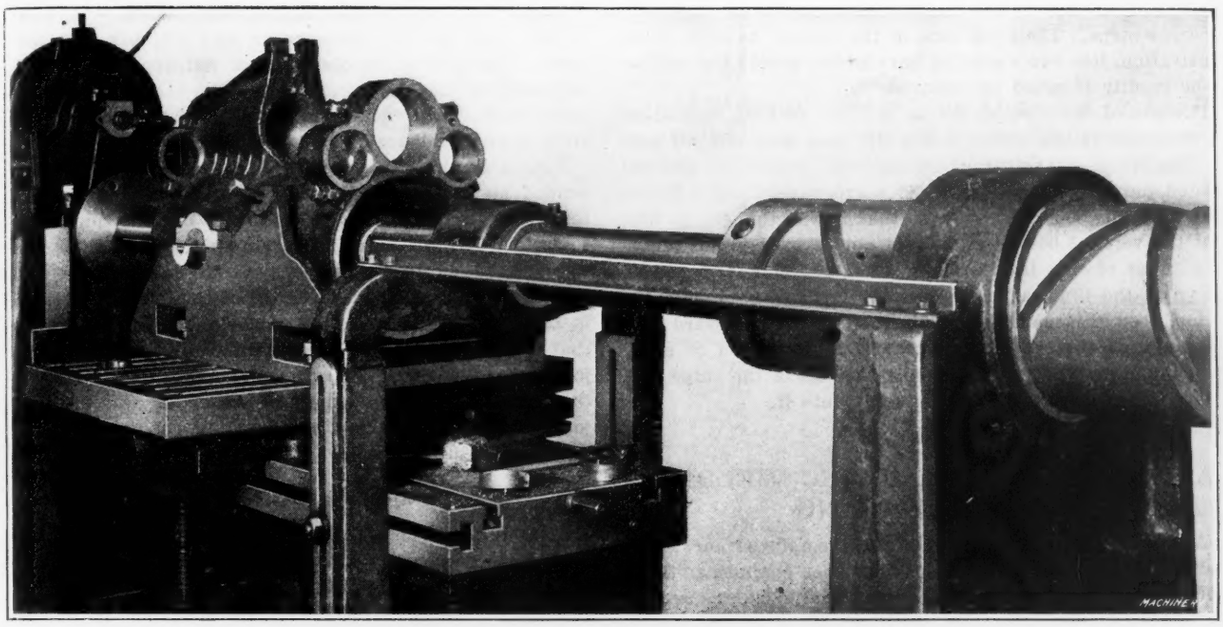


Fig. 14. Horizontal Boring Machine arranged for routing Oil-groove in Bronze Liner of Slide

operation. The oil-grooves extend around about two-thirds of the circumference of the bushing and branch out into a Y-shape at each end. One of the Y-shaped ends of each bushing is shown in the illustration. The horizontal spindle of the fixture is rotated for feeding the bushing past the routing tools, by handwheel *A*, which serves to revolve a worm meshing with wheel *B*. The axial movement of the fixture spindle is derived from cam grooves on each side of gear *B*. The shafts *C* and *D* carrying the rollers have rack teeth which engage the segment gears formed on the pivoted lever *E*. By swinging this lever in one direction or the other, the rollers are alternately engaged. When the left-hand roller is engaged with its cam groove, the left-hand branches of the Y-shaped oil-grooves on each bushing are milled, and when the right-hand roller is moved inward the right-hand branches of the oil-grooves are milled.

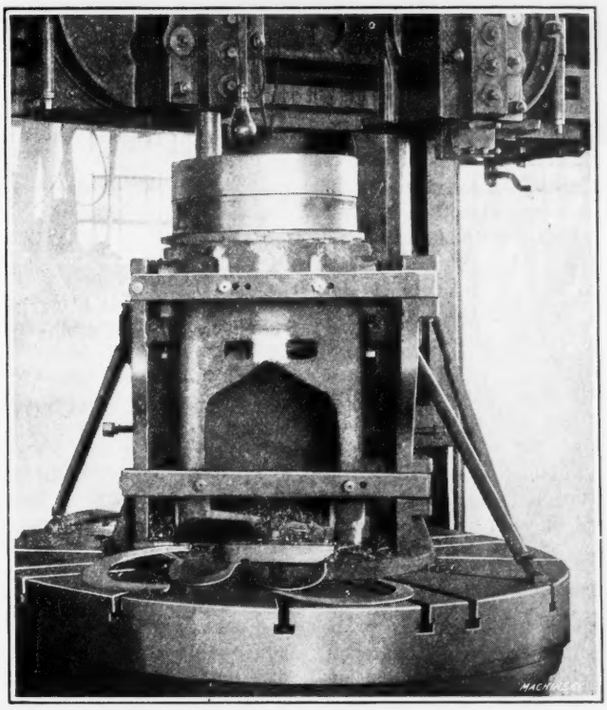


Fig. 15. Machining Carriage Casting on Vertical Boring Mill

Turning and Boring Operations on the Carriage and Stand

In machining large castings such as the carriage and stand casting, the vertical boring mill is used in preference to the lathe. The carriage is rather high for holding in an upright position, but by employing a heavy fixture of the type shown in Fig. 15, it is held securely. The advantage of using the vertical boring mill for this work is that the interior and exterior surfaces are machined at one setting, thus reducing the amount of time required and insuring concentricity between the different interior and exterior surfaces. The location of the casting in this fixture is

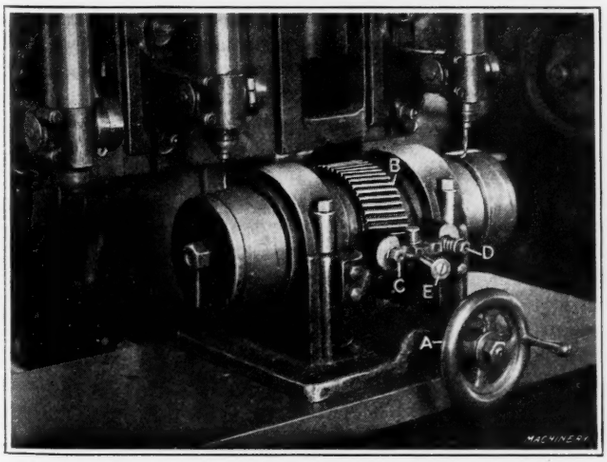


Fig. 16. Fixture for routing Oil-grooves on Two Bushings at One Time

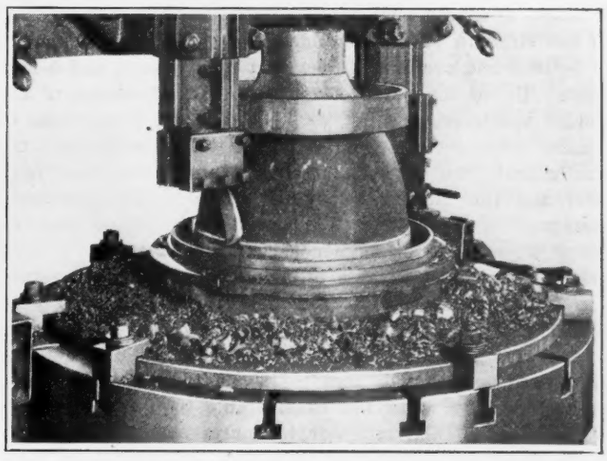


Fig. 17. Machining Stand on Vertical Boring Mill

checked by means of the lay-out lines, and it is supported by screw-stops. The front side of the fixture, as seen in the illustration, has two swinging bars which enable the casting to be readily inserted or removed.

The use of the vertical boring mill for turning operations on the stand is illustrated in Fig. 17. The most difficult part of this work was cutting the annular groove or channel around the base of the stand. This groove is about 5 inches deep and only 1¾ inch wide, so that it was thought at first that the vertical boring mill could not be used to advantage on account of chip interference, but the special form of tool shown in the illustration enables the work to be done satisfactorily on this machine. This tool curves backward considerably, so that any springing action is upward or away from the cut, and it is ground so that most of the chips curl out of the groove instead of jamming into it.

* * *

APPLICATION OF ELECTRIC WELDING TO SHIPBUILDING

Although electric welding has been employed for many years for ship repair work, its use has been confined to those parts of the structure that are not likely to be exposed to important stresses. However, the more advanced ship builders recognized that this method of construction offered almost endless possibilities and brought the matter to the attention of Lloyd's Register which arranged to carry out an exhaustive series of tests that extended over a period of six months.

One of the most important problems in shipbuilding is the joining of mild steel containing about 0.15 per cent carbon to the other structure. This material, in the process of manufacture, has been worked until it possesses a fine structure, its ductility is uniform in every direction, and it is practically free from fibrous structure. With electric welding, molten metal is attached to the mild steel and is cooled so rapidly that the weld tends to become deficient in ductility. The problem therefore is to select the material of the electrode so that the general elastic properties of the structure are not unduly depreciated.

The general scope of the experiments included the determination of the modulus of elasticity and the approximate elastic limit; the determination of the ultimate strength and the ultimate elongation, the application of alternating stresses with both rotating and stationary test pieces, cold-bending of welds, and impact tests of weld specimens; also chemical and microscopic analyses.

Results of Tests

The tests showed that the elastic limit appears to be slightly higher in the welded than in the unwelded material. The modulus of elasticity of a small piece composed entirely of material of the weld was about 11,700 tons per square inch as compared with about 13,500 tons for mild steel and 12,500 tons for wrought iron. The ultimate strength of small welded specimens was over 100 per cent of the strength of the unwelded steel plate for thicknesses of ½ inch and averaged 90 per cent for plates ¾ and 1 inch thick. Up to the point of fracture, the extensions of the welded specimens are not sensibly different from those of similar unwelded material. At stresses greater than the elastic limit, the welded material is less ductile than mild steel and the ultimate elongation of a welded specimen, measured on a length of 8 inches, is only 10 per cent, as compared with 25 or 30 per cent for mild steel. Welded specimens are not capable of being bent without fracture over the described radius for more than 80 degrees with ¼-inch plate, and the bend is reduced to about 20 degrees in the case of 1-inch plate. Unwelded material under the same conditions can be bent to 180 degrees. Welded plates can successfully withstand considerable impact.

The chemical and microscopic analysis showed that the material of the weld after deposition is practically pure iron, though it contains 0.03 per cent carbon, 0.02 per cent silicon, 0.02 per cent phosphorus, and 0.04 per cent manganese. The local effect of heat does not appear to affect the surrounding material greatly, and the structure is not disturbed about 1/16 inch from the edge of the weld. There is little if any evidence of oxidation.

Butt welds have a tensile strength of 90 to 95 per cent in welded plate. Lap welds with fillets on both edges have a tensile strength of from 70 to 80 per cent of the unwelded material. Riveted lap joints for plates ½ inch thick have a strength of 65 to 70 per cent of the unperforated plate. Broadly speaking, the tensile strength of large butt welds is as great as the unwelded material, but it is considered that greater reliability of workmanship is obtained with joints that are either lapped or strapped. It was also found that the lap joint is about as strong as the riveted lap joint, and will withstand more trying conditions than the riveted lap joint.

Regulations of Lloyd's Register

After full consideration of the subject the committee decided to recommend that probational rules should be adopted for the application of electric arc welding to shipbuilding, and that the approval of the society should be given to any process that complies with these regulations. These rules provide that before welding, the surfaces to be joined must be fitted close to each other and that all butt and edge connections are to be lapped or strapped. With lap connections the breadths of overlaps of butts and seams and the profiles of the welds are to be as follows:

Thickness of Plate, Inch	Width of Overlap Seam and Butt, Inches	Total Thickness, Inch
0.40 and under	2¼	0.28
0.60	2½	0.38
0.80	2¾	0.48
1.00	3	0.50

Intermediate values may be obtained by interpolation and for thickness below 0.4 inch plate, the thickness is to be about 70 per cent of the thickness of the plate.

* * *

THE MANUFACTURE OF FERRO-TUNGSTEN

Probably about half the consumption of tungsten, the leading alloy metal used in the manufacture of high-speed steel, is used in the form of ferro-tungsten and the remainder as tungsten metal. In a paper read before the American Institute of Mining Engineers, R. M. Keeney describes the method used in Colorado for manufacturing ferro-tungsten having approximately the following analysis: Tungsten, 75 per cent; carbon, 0.8 per cent; silicon, 0.4 per cent; manganese, 0.5 per cent; sulphur and phosphorus, both under 0.02 per cent. The initial charge consists of 65 pounds of a mixture composed of 200 pounds of concentrates (the composition of which is 60 per cent copper trioxide, 22 per cent iron, and 8 per cent sulphur bioxide), 42 pounds of coke, and 6 pounds of fluor-spar. Three more similar charges are added at intervals of about thirty minutes. After 2½ hours the furnace is tilted and the slag poured off. These operations are repeated until, after from twenty-four to thirty-six hours, a "button" weighing about 1200 pounds is produced. The furnace is then allowed to cool. The button is then removed, cleaned, and broken into small pieces and refined. For refining, a charge consisting of 150 pounds of crude metal and 75 pounds of the concentrates is melted for thirty minutes, and 12 pounds of fluor-spar is then added. After three hours the slag is poured off and a fresh charge added. This is continued for about thirty-six to forty-eight hours, or until a 1500-pound button is produced. The furnace is again allowed to cool and the button is removed, cleaned and broken as before. The refining lowers the carbon content from 3 per cent to 0.8 per cent and the refining slag, containing from 5 to 20 per cent of tungsten, is smelted in a special run.

The Laying Out of Patterns

By Joseph A. Shelly

Methods of Making the Drawings or Lay-outs that are Required by the Patternmaker in Planning His Work, Together with Allowances Necessary for Draft and Shrinkage and for Machining Castings in the Shop

IN order to make patterns with the greatest economy of time and materials, it is usually advantageous to have a full size drawing or lay-out to work to. The lay-out should be made on a smooth board, the lines being scribed with a sharp knife, gage, or divider points. The drawing should be made as accurately as possible according to the contraction rule measurements and should show clearly all details of construction as well as all partings, core-prints, core joints, and the location of loose pieces. The amount of draft and finish should be noted, and the finish is often indicated by blacking the lines with lead to indicate the amount allowed. Sections on the lay-out are section-lined by hand or by chalking the spaces between the lines. If the lay-out is so large that it has to be made on the floor, it is whitened with chalk where the lines are to be.

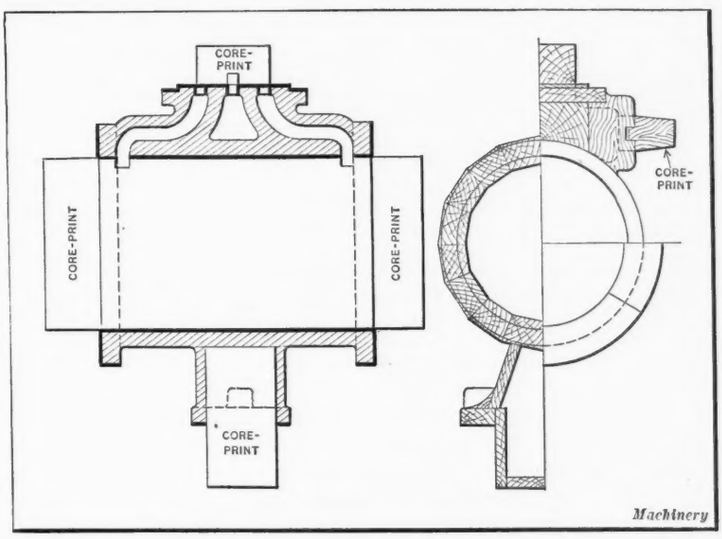


Fig. 1. Patternmaker's Lay-out for Steam Cylinder

A lay-out is not required unless a job is more or less complicated or has angles or curves that cannot be transferred directly from the draftsman's drawing to the pattern. An entire drawing is not always necessary; very often laying out a single section full size will answer every purpose. The advantages of the lay-out are that it clears up obscure points on small scale drawings and gives a chance to show pattern structural details as well as the pattern and loose-piece partings and core joinings. Angled and curved faces may be checked by bringing them into contact with the lay-out, and a number of men can work to greater advantage than they could from a drawing. A patternmaker's lay-out for a steam cylinder is shown in Fig. 1.

Right- and Left-hand Patterns and Core-boxes

Many patterns are required to be in pairs and when their form is such that they cannot be reversed and have the centers of hubs, bosses, etc., opposite and in line, they must be made right- and left-hand. If the pattern is a small one or if a great many castings are to be made from it, the better way would be to make two patterns, but if the pattern is large or if only one or two castings are required, the work should be laid out and planned so that the required pieces may be moved from side to side or from end to end in order to change the pattern from right- to left-hand. The bracket shown in Fig. 2 is an example. The hub *A* and the foot flange *B* are fastened with screws and are moved from side to side to make the pattern right- and left-hand, as indicated by the dotted lines. The ribs are also loose; rib *C* is reversed, but right- and left-hand ribs *D* are required, because of the angle at the lower edge. Cores made in half boxes must frequently be right- and left-hand, and by good planning a single box can often be utilized.

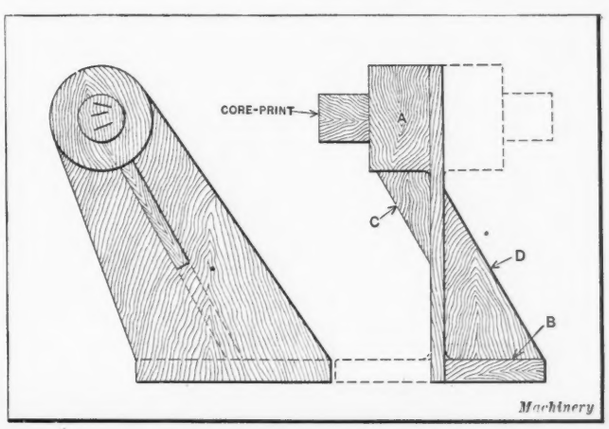


Fig. 2. Right- and Left-hand Pattern

Provisions for Machining Castings

In planning a pattern, some consideration should be given to the shop facilities for handling the casting during the machining operations. A very little extra work in the pattern shop will often save hours in machine shop work. A small boss cast on pieces that cannot otherwise be fastened conveniently to a faceplate (see example *A*, Fig. 3) or a bridge left in each end of a hollow cylinder to accommodate the lathe centers (see example *B*) often greatly facilitates the machining of castings of this type. Lugs *a* and feet *b* on a casting of the general type shown at *C* are frequently used to facilitate leveling and clamping for the machining operations. Ring pipes *D*, used for making piston rings, are ordinarily provided with lugs for fastening to a faceplate. The number of lugs used should be regulated by the slots in the shop faceplates; four is the usual number, but, on small rings, sometimes only two lugs are provided, with the addition of two feet for steadying. The lugs may project either outward or inward, depending upon the size of the pipe and the size of the faceplate to which it is to be fastened. If the pipe is as large or larger than the faceplate, the lugs should be placed on the inside, but if it is smaller than the faceplate, the reverse method is used. The lugs, instead of being fastened directly to the bottom of the ring, are more often made with an added thickness between the lug and the ring, as shown at *E*. This permits using the entire ring.

Tool clearance spaces are sometimes formed on a pattern to provide an open space for the tool to enter when finishing portions of the casting that are partially or entirely enclosed. Holes that are to be tapped for screw pipe connections in bosses or other thick portions of castings should be provided with

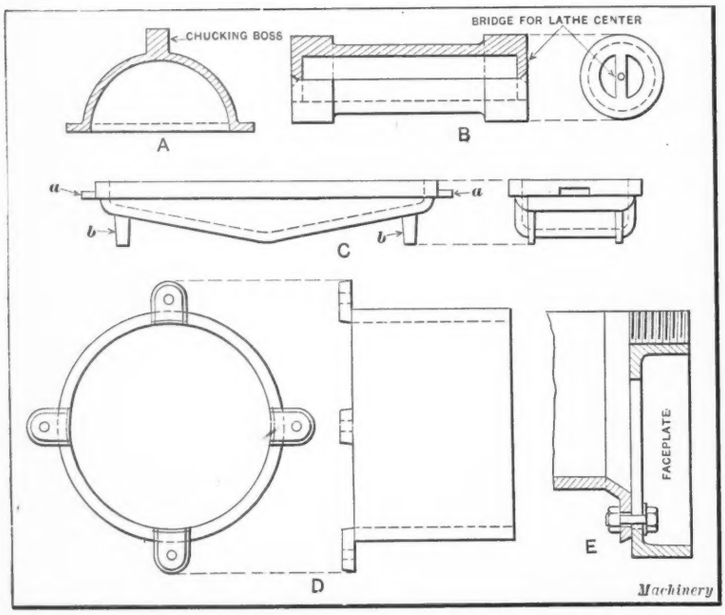


Fig. 3. Examples illustrating Provisions made on Patterns for machining Castings

a chamber or recess larger than the outside diameter of the tap so that the end of the tap will have a clearance space (see sketch *A*, Fig. 4). Frames that are to be machined inside should have tool clearance provided at the corners, as at *D*. Slots closed at one or both ends should be similarly arranged as at *B*. Flanges that are to be turned, when it is not possible to make a complete revolution on account of projections, should have tool clearance arranged as at *C*.

Coring Bolt and Pipe Tap Holes

The lay-out should always take into consideration the difficulty of drilling holes in inaccessible parts of large castings and arrange to core them whenever possible. Foundation bolt holes in beds, bases, large cylinder feet, etc., should be cored, and also holes that are to be tapped for pipe connections. Bolt holes are cored over size so that the bolts will slip through easily, but a cored hole for a pipe tap or other tap must have an allowance for machining, as the tap is never forced into the rough cored hole. The proper amount to allow for finishing will vary with conditions. This can be obtained from a table giving the tap drill sizes for pipe, by allowing finish on the drill dimensions.

Draft on Patterns

Draft is a tapering of all the vertical faces of a pattern to permit its removal from the sand without excessive rapping on the part of the molder. There is no rule fixing the amount of draft to give a pattern. A good plan is to give as much draft as possible without distorting the pattern; this may vary from 1/32 to 3/16 inch or may even be as much as ¼ inch per foot of height. The draft always runs away from the pattern face; that is, the pattern face is the larger side of the pattern. If none of the faces are at right angles to the pattern face, then no draft will be required. Very small patterns and those of larger sizes to be used in molding machines are often made without draft.

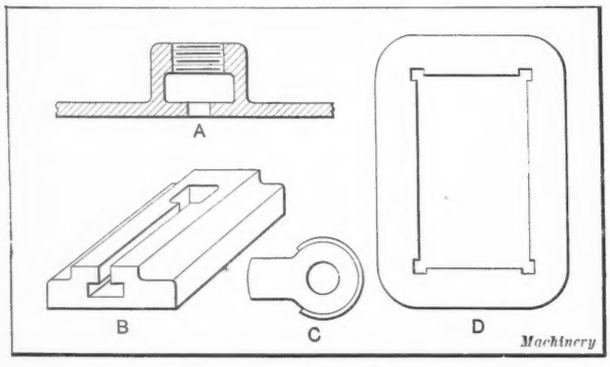


Fig. 4. Pattern provided with Tool Clearance Spaces

Contraction or Shrinkage

Contraction or shrinkage allowance is the amount that a pattern is made over size to compensate for the contraction of the casting metal. The total amount that a casting will shrink depends largely upon its size and shape. If it is long and rather light, it will shrink more than a casting of the same weight but of more compact shape, even when cast in the same metal and under the same conditions. Cylinders and column-shaped castings will shrink more lengthwise than radially. They will shrink about 1/10 inch per foot lengthwise, while the radial shrinkage will be from 1/20 to 1/16 inch per foot.

A rule used by foundrymen producing columns for building purposes is to allow ⅛ inch per foot on the length and nothing on the diameter. A shrinkage of 1/10 inch per foot is considered the standard for machine castings, and although it is not the proper amount for all forms of castings, it averages up pretty well and does away with the confusion that would naturally follow the use of a number of shrinkages for different parts of a job or different forms of castings. Although there is no fixed rule governing this question, experience has shown that the amounts given in the accompanying table, "Shrinkage of Castings," are approximately correct.

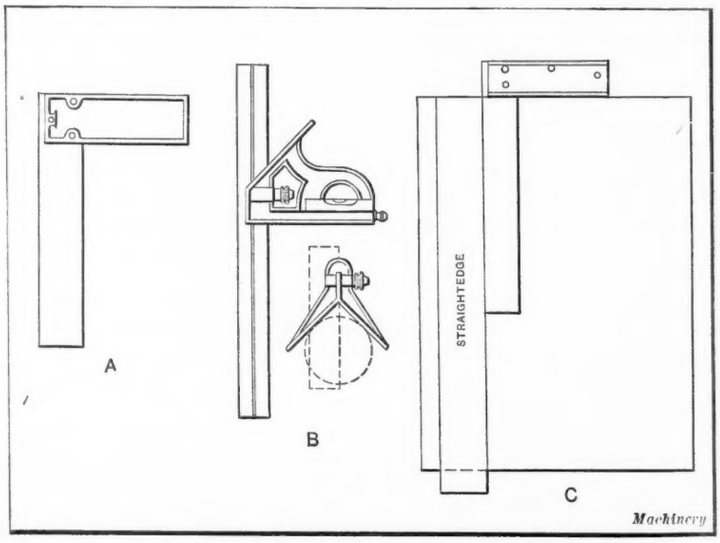


Fig. 5. Squares used for laying out Patterns

Contraction or Shrinkage Rule—Finish Allowance

The contraction rule is a special rule with the shrinkage of the casting metal added. It is made of steel or wood and in appearance does not differ from an ordinary rule, but when compared with a standard rule it will be found longer; a two-foot contraction rule for ⅛ inch shrinkage to the foot will be ¼ inch longer than the standard rule. These rules may be procured for all the standard shrinkages, including the steel rules in one- and two-foot lengths and the wooden ones in the straight two-foot size, as well as the same length with a single fold or hinge at the center.

In addition to the shrinkage allowance there is still another allowance to be made, and that is the finish or amount that will have to be added to certain parts of the casting to permit them to be finished or machined to the proper size. This amount varies widely, depending on the size of the

casting, the methods of machining it, and the degree of finish required. Castings to be finished from the rough on disk grinders require but little finish allowance. It is the practice in some shops on this class of work to let the molder's rapping allow for the finish. On small or medium-sized work that is to be finished in the lathe, planer, or milling machine, about ⅛ inch will be enough for the machining operations, but for the larger pieces such as engine beds, flywheels, etc., the finish will vary from ¼ to ¾ inch. An extra finish allowance is usually made on the cope side of large castings to permit machining to the sound metal that lies beneath the dirt that always floats to the top of a mold while the metal is in a liquid state.

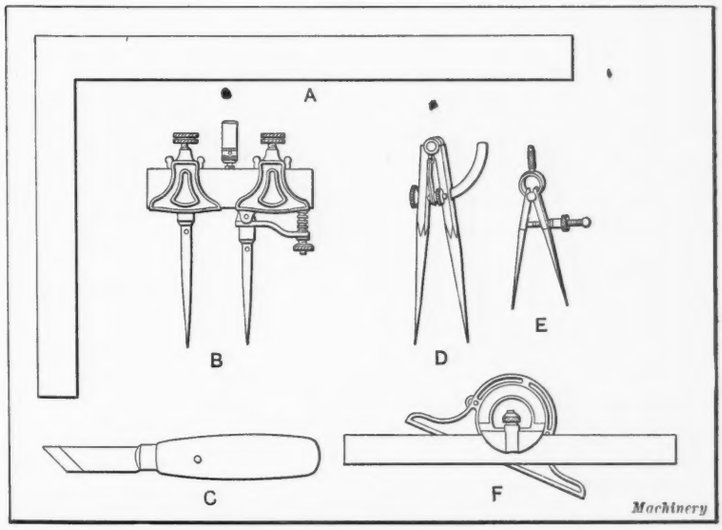


Fig. 7. (A) Steel Square. (B) Trammels. (C) Knife for ruling Fine Lines. (D and E) Dividers. (F) Bevel Protractor

Stock List

A stock list should be made of all the pieces that are to be used in the construction of a pattern. This list should give the thickness, width, and length of all pieces required. In cabinet shops, the stock list sizes are "neat" or exact finished sizes, and allowance for machining must be made in roughing out stock. This is a good plan to follow in pattern work, but it would be safer to let the width and length go until the pieces are to be used.

Tools and Appliances Used in Laying out Patterns

Lay-out boards, of which there should be a number of different sizes in every shop, are made of light soft material, preferably white pine, and battened to keep them straight. They should be planed perfectly smooth and one edge should be absolutely straight. All gaging and squaring should be done from this edge.

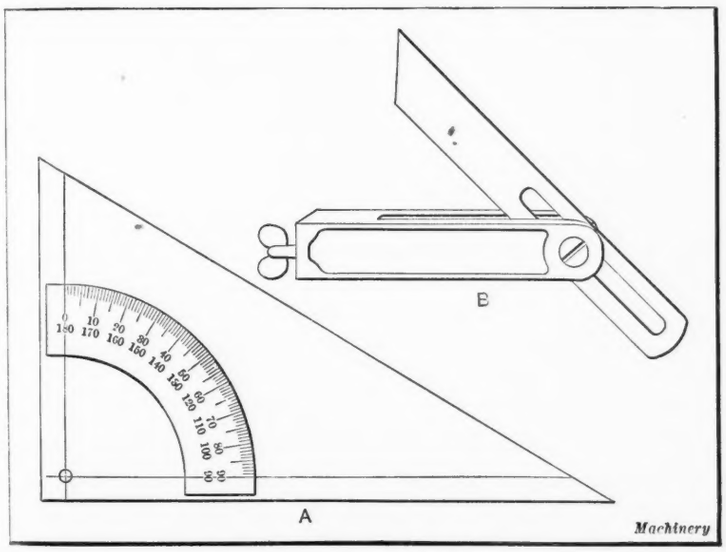


Fig. 6. (A) Set-square. (B) Bevel

The tools used for laying out work include try-square, set-square, steel framing square, bevel, marking gage, panel gage, trammels, wing dividers, protractor, straightedge, and knife.

The try-square *A*, Fig. 5, is used for drawing all cross-lines. The blade should be long enough for the work in hand, but when used in connection with the straightedge, as illustrated at *C*, the line may be extended beyond the limits of the square blade. The adjustable combination square *B* is very popular with patternmakers, as it may be used in places where the fixed-blade square would be useless. This square is usually sold in combination with the center head shown in the same view. A protractor head may also be procured, which increases the scope of the tool. The size of a square is determined by the length of its blade; for pattern work, this will be from 6 to 24 inches. For general bench work, two blades, 6 and 12 inches long, respectively, are useful. If the adjustable-blade square is used, one 12-inch blade is satisfactory for general work. An 18-inch size is handy for lay-out work, but lines of any length may be squared when the square is used in connection with a straightedge.

The set-square *A*, Fig. 6, is a thin wooden triangle used in connection with the straightedge for squaring from lines at angles to the edge of the lay-out board. A protractor is frequently laid out on one face of the set-square, to set the bevel to various angles.

The steel square *A*, Fig. 7, is useful in lay-out work, because it will lie flat on the board or pattern. The graduations on this square are omitted in the illustration. The wider and longer section is usually 2 inches wide and 24 inches long, and is called the body or blade; the narrow part is 1½ inch wide and from 16 to 18 inches long, and is called the tongue. The side with the maker's name stamped on it is called the face, and the edges are graduated in sixteenths, twelfths, eighths, and quarters of an inch. It has various scales for laying out rafters, braces, and for solving other problems met with in building construction. The Essex board measure will be found on the back of the blade. The figure 12 in the graduation marks on the outer edge represents a 1-inch board, 12 inches wide, and is the starting point for all calculations; the smaller figures under 12 represent the length. To determine the square feet in a board 6 inches wide and 8 feet long, find the figure 8 under the 12-inch graduation mark, and then pass the pencil to the left on the same line to a point below the graduation mark 6, representing the width of the board, and the result will be read as 4 board feet. If the stock measured is 2 inches thick, the result will have to be doubled.

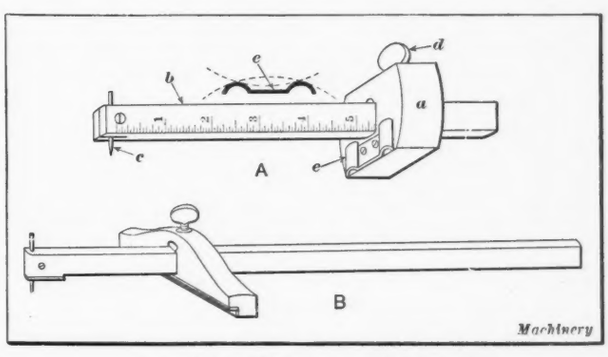


Fig. 8. (A) Marking Gage. (B) Panel Gage

The bevel *B*, Fig. 6, is used for laying out and testing angular surfaces; it consists of a stock with a slotted blade that can be set and locked at any angle. The winged thumb-screw at the end of the stock is used to clamp the blade in position.

The marking gage *A*, Fig. 8, is used for drawing lines parallel to the working edge. It consists of a head or stock *a* and a bar or beam *b* provided with a spur *c*. The beam is fitted to the through mortise in *a* and is secured at any point in its length by the thumb-nut *d*. By clamping the bar so as to bring the spur a given distance from the stock, a like distance may be gaged from any straight edge. The back of the stock is sometimes provided with a shoe *e* which facilitates gaging from convex and concave edges. The beam is usually graduated in inches, subdivided into sixteenths. In pattern work, these graduations should be disregarded. The gage should always be set to a rule, the gage being held in the right hand and the rule in the left, the measurement from spur to gage-head being made on the edge of the rule. The final adjustment in setting is made by tapping the ends of the beam on the bench to move it in or out. The panel gage *B* is used for the same purpose as the marking gage. It is larger and has a longer beam, but otherwise does not differ from the marking gage.

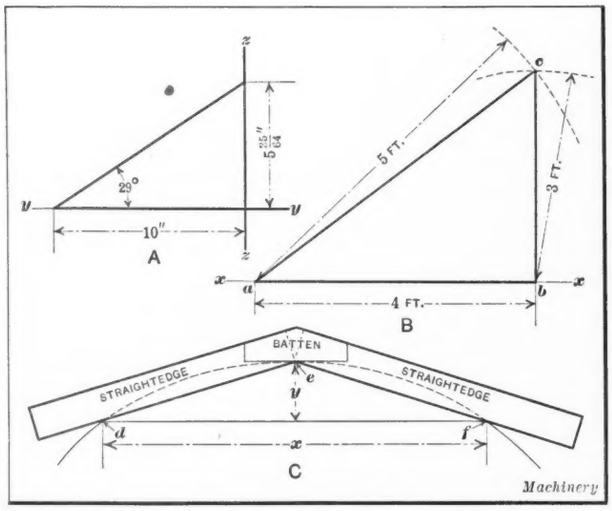


Fig. 9. (A and B) Laying out Angles. (C) Laying out Arcs of Large Radii

The trammels *B*, Fig. 7, are used for scribing large circles. They are used in connection with a wooden bar, to which they are clamped with thumb-screws. In drawing large circles with a long bar, the vibration of the bar will cause the scribing point to chatter; to overcome this, a bar too large for the opening in the trammel is used, and it is cut down on the ends to fit. The winged dividers *D* are used for drawing medium-sized circles, generally not exceeding 12 inches in radius. The size is designated by the leg length. The spring dividers *E* are used for drawing small circles and for accurate spacing, as for gear teeth, etc.

The protractor *F* is used for laying out the smaller angles. The size with an 18-inch blade is very handy for lay-out work. Protractors for setting a sliding T-bevel are sometimes laid out in the set-square as shown at *A*, Fig. 6. The straightedge is used for ruling lines and in connection with the try-square and protractor. Several lengths should be on hand in every pattern shop, and it is an advantage to make them with parallel edges.

The knife is used in connection with the straightedge or square for ruling fine lines across squarely or at an angle to the working edge of the pattern or lay-out board. It is also used for rounding the corners on small pattern work. The knife may be of the type shown at *C*, Fig. 7, or it may be an old pocket knife ground for this purpose.

Laying out Angles

Large right-angled triangles may be accurately laid out by what carpenters call the "three, four, and five rule." This rule is based on the fact that the square root of the sums of the squares of the base and altitude of a right-angled triangle will equal the hypotenuse. To construct a triangle this way, a base line *xx* of convenient length is laid out and on it two points *a* and *b* are marked four feet apart as at *B*, Fig. 9. With *b* as a center a 3-foot arc is scribed to intersect a 5-foot arc struck from point *a*. A line drawn from *b* through the intersection *c* of the two arcs will be at right angles or 90 degrees from the base line. These numbers may be increased by multiplying both by the same figure, or decreased by dividing both by the same figure without changing the proportions.

Any angle can be accurately laid out by means of a table of natural tangents. As an example suppose it is desired to lay out an angle of 29 degrees. First a base line *yy* is drawn (as at *A*, Fig. 9) of indefinite length, and a perpendicular *zz* is erected. A point is marked on the base line exactly 10 inches from the perpendicular. By consulting the table of tangents it will be found that the tangent of 29 degrees is 0.55431; mul-

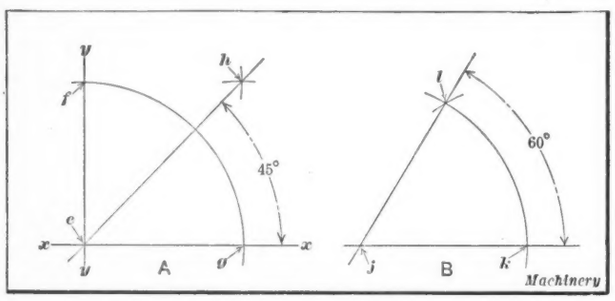


Fig. 10. Laying out Angles of 45 and 60 Degrees

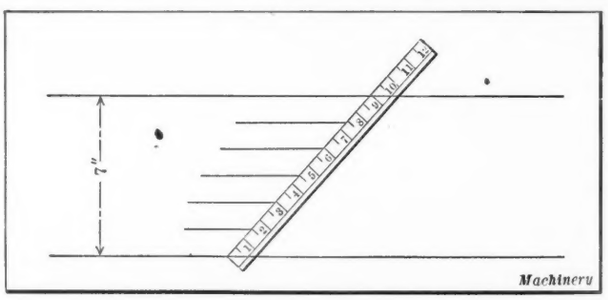


Fig. 11. Simple Method of spacing Parallel Lines

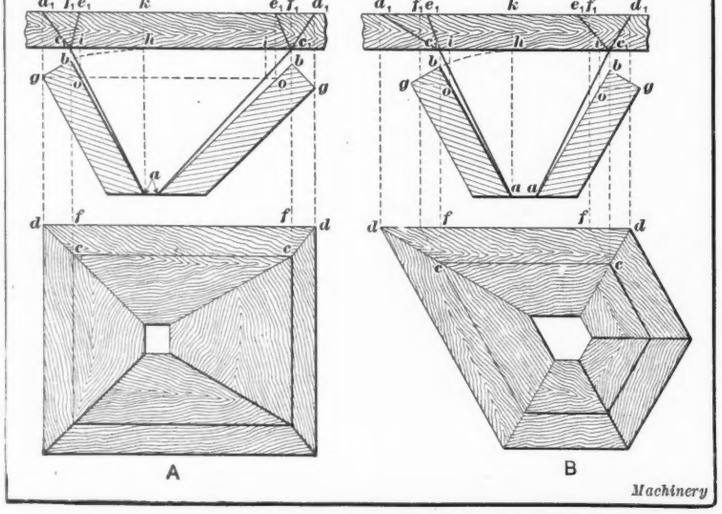


Fig. 12. Method of laying out Bevels for Hopper Patterns

tiplying this by 10 gives 5.5431 (or $5\frac{35}{64}$ inches approximately), which is the distance to lay off on the perpendicular measuring up from the base line. Connecting the point thus obtained, with the point on the base line gives the desired angle. The angularity of two lines may also be determined from the table of tangents by dividing the height on the perpendicular by the length on the base line; the quotient thus found equals the tangent, and the corresponding angle will be found in the table.

Angles of 45 and 60 degrees and equal divisions of them can be quickly laid out without reference to a protractor or table. For a 45-degree angle, draw a base line *xx* and erect a perpendicular *yy*, as at *A*, Fig. 10. With *e* as a center, draw a quarter circle of any convenient radius, and then, with *f* and *g* as centers, describe two arcs. A line drawn from *e* through the intersection *h* of the two arcs will be at an angle of 45 degrees to the base line *xx*. A 60-degree angle may be laid out as at *B* by drawing a quarter circle from

SHRINKAGE OF CASTINGS

Usual Allowance for Each Foot in Length

In large cylinders...	$\frac{3}{32}$ inch	In zinc.....	$\frac{5}{16}$ inch
In small cylinders..	$\frac{1}{16}$ inch	In lead.....	$\frac{5}{16}$ inch
In beams and girders	$\frac{1}{10}$ inch	In tin.....	$\frac{1}{4}$ inch
In thick brass.....	$\frac{5}{32}$ inch	In copper.....	$\frac{5}{16}$ inch
In thin brass.....	$\frac{3}{16}$ inch	In bismuth.....	$\frac{5}{32}$ inch
In cast-iron pipe....	$\frac{1}{8}$ inch	In malleable iron.	$\frac{1}{8}$ inch
In steel.....	$\frac{1}{4}$ inch	In aluminum.....	$\frac{1}{8}$ inch

Machinery

point *j* and then describing an arc from *k* with a radius equal to the radius of the circle. A line drawn through the point of intersection at *l* will be at an angle of 60 degrees with the base line. Equal divisions of these angles can be made by bisecting.

Laying out Arcs of Large Radii

To lay out the arc of a circle which is so large that it would not be practicable to use a pair of trammels, the length *x* of the chord (see diagram *C*, Fig. 9) and the height or rise *y* must be known. This gives three points *d*, *e*, and *f* through which the arc must pass. Brads are driven at these points so that they will project about an inch above the surface on which the circle is to be scribed. A triangle is constructed of two straightedges, each of which should be longer than the chord; these are placed against the brads with their ends in contact at *e*, where they are fastened together with a batten. The brad at *e* is then removed and a scriber or pencil substituted; this will describe the desired arc when the triangle is moved to the right and left with the inner edges bearing against the brads at *d* and *f*.

When laying out arcs of large radii by this method, the height *y* of the chord may be assumed and the length *x* calculated by the following rule: To determine length *x* of the chord for a given height *y*, subtract *y* from the diameter of the circle of which the arc forms a part, and multiply the remainder by height *y*; then extract the square root of the result and multiply the square root by 2, thus obtaining the length *x* of the chord. The height *y* should be selected so that the length of the chord will neither be too short nor too long. If the length is too short, this will also limit the length of the arc which may be drawn, and if it is too long, it will be necessary to use straightedges which are also long and unwieldy. By considering an imaginary arc of the required radius, the relation between the height of the chord and the length of the arc may be determined approximately.

Equal Spacing between Parallel Lines

The space between parallel lines can be quickly laid off into equal divisions by holding a rule at such an angle that the distance indicated can be divided easily. For example, the distance between the two parallel lines shown in Fig. 11 is 7 inches, and this distance is to be divided into six equal parts. The rule is placed at such an angle that the distance indicated is 9 inches, which can easily be divided by six. Thus $9 \div 6 = 1\frac{1}{2}$; hence, points laid off along the rule $1\frac{1}{2}$ inch apart will divide the 7-inch space into six equal spaces.

Bevels for Hopper Patterns

Laying out the bevels for hopper patterns is a good example of laying out work. The drawing *A*, Fig. 12, represents a rectangular hopper, one side of which is set at a different angle from the others, while *B* is a hopper, one side of which conforms to an equilateral triangle in shape, while the other side is a section of hexagon. The two drawings are lettered alike so that one description, with a little variation, will apply to both. A perpendicular is first erected at *a*, and a distance *ah* is laid off equal to the width of the stock, or *ab*. A line drawn through *h* parallel with the base represents the upper edge *cc*. The length of this edge is the same as that at *cc* on the plan, so that, by erecting perpendiculars at each end from *c* or directly from *b* on the elevation, the points c_1c_1 are obtained; then by drawing lines from *aa*, the side angles may be obtained. To obtain the angles across the edge of the board, lay off the board thickness from *h* to *k* and draw through *k* a line parallel to c_1c_1. To obtain the angle for a miter cut, a perpendicular is drawn from *d* to d_1; then by drawing a line from d_1 to c_1 the angle to which the bevel should be set is obtained.

To obtain the angle for a butt-joint, a perpendicular is erected from *f* to f_1, which would be a point in the butt-joint if the top edge of the board were level, the board being in a vertical position. The board or side of the hopper, however, is inclined; the outer edge is lower than the inner one, and point *o* is level with the corners *g*. A vertical line is erected from point *o*, and the distance from corner *b* to line *oi* is transferred to f_1e_1. A line drawn from e_1 to c_1, corresponds to the angle for the butt-joint. This end or edge of the board would be square in the case of a butt-joint, if the side of the hopper were vertical instead of being inclined.

Transferring Lay-out Lines to Stock

In "picking up" or transferring lines from the lay-out to the stock, not much trouble will be experienced with those that are straight, even if they are not square with the lay-out edge, as they may be drawn any length, the stock being laid on the lay-out in proper position and the line transferred by marking the points where they coincide with the edges. It is often necessary, however, to transfer lines that may be either irregular curves or arcs of circles. These may be "picked up" by using small flat-headed wire nails, about the cigar-box size, laid flat with the heads in a row in the line to be transferred and placing the stock on top of the nail-head edges; the line may then be transferred by striking the stock a sharp blow with a mallet, which causes the nail-heads to mark the stock.

* * *

PAPER DRIVING BELTS

It is said that paper driving belts have been introduced into German work-shops. The paper is cut into narrow bands which are then spun, and the belts are made by weaving or braiding. Woven belts are of two kinds—paper fabric and paper thread—the fabric being more often used. The fabric is first cut into bands about 12 feet long, which are subsequently made into the desired width and thickness. A strengthening core is interposed, made of either cotton or sheet metal, though more recently the cores have been made of interwoven paper thread and metal wires. The core is encased in paper strips and the whole is then sewn with strong thread. These belts are said to be very flexible and to wear satisfactorily. The tensile strength is from 560 to 700 pounds per inch of width.

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A NATIONAL RESEARCH LABORATORY

The war has stimulated research as probably no other condition could have done. Before the war American manufacturing firms, with few commendable exceptions, spent but little money on research work. Generally they were inclined to develop their product gradually by "cut-and-try" methods, demonstrating by costly experiment the practicability of new machines and devices.

The large electrical companies and a few manufacturers in the chemical and allied industries maintained research laboratories, and much of the progress in those fields has been due to patient work done by their engineers and chemists. In the machine industries, however, comparatively little research work has been done, an exception being the important work accomplished by Frederick W. Taylor. The Bureau of Standards has now apparently taken up this work in earnest, and in the near future we are likely to have a real national research laboratory where industrial problems can be thoroughly investigated by engineers and scientific men who devote themselves exclusively to such work. We hope that Congress will wholeheartedly encourage this undertaking by ample appropriations, as has been done in Great Britain. Eventually it is much cheaper to develop such problems to a certain point by experiments in a research laboratory than by guesses and failures in actual industrial work. A bad guess may cost only a few dollars in the laboratory, but in actual practice hundreds or thousands may be involved.

A thorough investigation of the subject of tolerances in machine construction would prove invaluable to thousands of manufacturers, and is an example of the practical work which might be done by a national laboratory. Tolerances are mentioned, because lack of definite information on the errors allowable in manufacturing different classes of tools, munitions, etc., and the adoption of unnecessarily small tolerances on government work, not only increased the manufacturing cost from one hundred to several hundred per cent in some cases, but resulted in a loss of time which, during the recent crisis, was far worse than the monetary loss. Money appropriated for the equipment and maintenance of a government laboratory, working for and in cooperation with the manufacturers of the country and engaged in the solution of any and all problems which affect our industrial welfare, would be a gilt-edged investment.

* * *

THE VALUE OF SPECIALIZATION

The specialization in manufacturing that has characterized American methods for the past twenty years is one of the important factors in our industrial supremacy. Some American machine tool builders construct a machine around a product. Some American manufacturers, like Henry Ford, build a plant around a product. A specialist using the latest methods and machinery, and producing in quantity, is always able to turn out machines more rapidly, and consequently at a lower cost, than a manufacturer who is not equipped for similar work, and this cost reduction carried out extensively, as it is in this country, represents a distinct gain to the nation.

A striking illustration of time-saving occurred some years ago when a concern specializing in a certain line of machine tools received an order for twenty machines, which it accepted subject to delivery in a year. The prospective customer was a machine tool builder, and he decided that he could turn out the machines in his own works in less time. After some negotiation he made what seemed to him a liberal arrangement—to buy the castings from the original manufacturer and obtain a set of blueprints of the machines and all the advice necessary, for which he was to pay only 5 per cent of the cost of the castings. But after a year had passed he had completed only seven machines and in two years had only thirteen at work.

When we consider that thousands of shops in the United States are specialized to make one product in each shop, we can understand why the principle of specialization has become a national asset and why our machinery manufacturers should be able to hold a good share of the world's markets.

* * *

THE INDUSTRIAL PROSPECT

It is already evident that the forecasts of industrial depression which prevailed at the signing of the armistice were inaccurate. The industrial future now looks bright, not only in these United States, but in Great Britain, France, Belgium, Italy, and Scandinavia. One important and universal factor in the situation is the attitude of labor, which has the power to block development by insisting on unreasonable demands. Another factor in this country is the proposed government ownership of railroads and other public utilities. The necessity for definite action on this question is evident to those who believe in government control, but are opposed to government ownership and its inseparable political evils. The prospects look favorable for a settlement of this question which will ensure the multitude of railroad owners a fair return on their investments, and open up a new future for railroads and all the industries dependent upon them.

The process of readjustment in Great Britain and France is described in an article in this number, and shows that the various industries are proceeding systematically and successfully to assimilate or distribute the vast stocks of merchandise and machinery that have been accumulated for war purposes, and are already going on with the manufacture of material to meet the demands of peace. If figures do not lie, France in time will become the largest iron and steel producing nation in Europe, and may have about one-half the iron and steel capacity of the United States.

Manufacturers everywhere should guard against hasty action and immature conclusions in regard to the future, especially against delay in buying required equipment and stoppage of production which will probably be required under normal conditions. There are more than one hundred million people in the United States who will continue to live and enjoy life now that peace has returned, and several hundred millions in foreign countries, of whom many lack even the necessities of life. The wheels must be kept turning to supply these wants.

Industrial Lessons of the War

THE great war has effected profound changes in the political structure of the world; great nations have melted away and new ones are rising from the ashes of the old. It is realized by thinking men everywhere that in the industrial world also great changes impend. The war has taught us more industrial lessons than we could have learned during decades of peace. Our future progress depends largely upon how thoroughly we have learned these lessons. We know far more about our capacity for production than we did four years ago; we know the value of cooperation between concerns engaged in the same lines of manufacture; we know that women can fill many places formerly held by men in the industries; we know that differences between employer and employe can be settled without prolonged and disastrous strikes and lockouts.

During the war period, many manufacturing concerns were forced to maintain production with smaller forces, or had to greatly increase production without an appreciable increase in personnel. This problem was solved by able management in a manner that five years ago would have astounded the very people who accomplished it. We have seen firms maintain their output when the draft and other causes had depleted their force by one-third; while others doubled their output without increasing their manufacturing facilities, and with but a slight increase in their working force, simply by adopting more efficient methods—by stopping the leaks that formerly prevented intense production. As a result, in such plants there is a basis for maintaining the higher wages demanded by labor without retaining the extreme price levels that were forced by the war.

The benefits to be derived from cooperation and friendly relations between competitors were well demonstrated during the war effort. Manufacturers visited one another's plants and carried away with them many ideas valuable in their own line. They exchanged blueprints of jigs, fixtures, and other devices used in the manufacture of shells, gun carriages, and other war materials, and, in some instances, borrowed tools from one another so as to save the unnecessary expense of duplication. This principle, applied in peace times, would enable manufacturers to cut production costs greatly, and the friendly relations thus established between competitors would aid rather than injure each individual manufacturer. Gear manufacturers have already taken a step toward this goal by laying plans for exchanging hobs—one of the most expensive tools in the gear industry.

Under a railroad administration endowed with extraordinary and unprecedented powers, the railroads, in a very trying and difficult period, demonstrated effectively the immense value of cooperation and coordination. The crisis demanded the concentration and cooperation of all railroad facilities. So facilities were merged, duplications of service were discontinued, and every effort was focused on the big job in hand. Millions of soldiers were carried from every point of the compass to the army camps, thence to the seaboard, and now again back to their homes. Ordinary passenger facilities were greatly cut down in order to handle the armies, involving also the carriage of a vast amount of freight; and it is a fact that with a slight decrease in the number of available freight cars, there was an appreciable increase in the percentage of freight carried.

The adaptability of women for industrial work is destined to have a profound influence on industrial development. They have demonstrated their ability to perform many kinds of work for which they were formerly not thought suitable. It is likely that many will be permanently employed in inspection work and small assembly work, leaving the work requiring greater physical strength and mechanical skill to the men. The total result necessarily must mean greater efficiency—that is, greater production per community, which should mean better living conditions for the individuals.

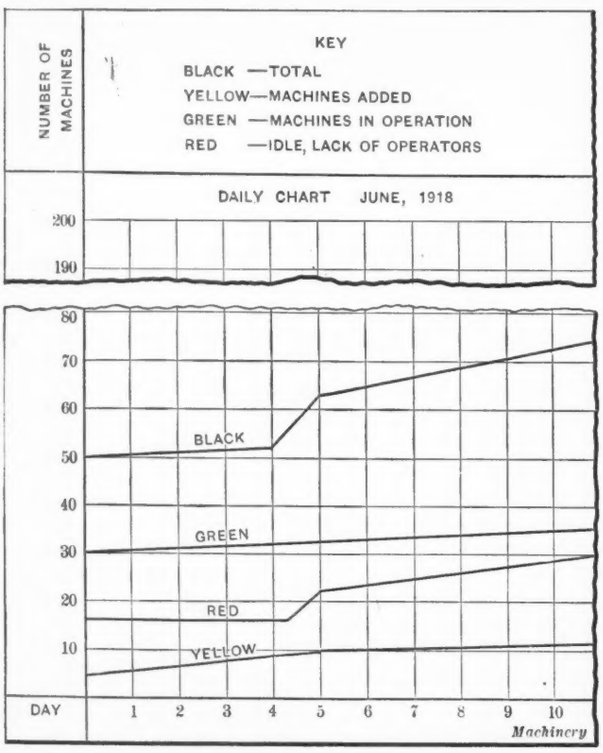
Methods have been developed whereby industrial disputes have been peacefully settled, and there is an opportunity for further progress along the same path. There has been gradual recognition of the fact that the interests of capital and labor are mutual. As yet, of course, this is but dimly conceived, but when the serious and fair-minded among employers and employes earnestly devote themselves to the solving of the greatest of industrial problems, it will not prove incapable of a just and entirely satisfactory solution.

USE OF CHARTS IN THE EMPLOYMENT DEPARTMENT

BY RUSSELL WALDO

Since the graphic chart made its appearance in the industrial world it has opened sources for improvement and has created avenues of planning that have made remarkable changes in manufacturing conditions. Not many years ago it was considered a complicated form of report and was thought to have little or no value to other than the college graduate. This belief has gradually changed until today it is as simple to read as the ordinary blueprint.

The presentation of facts in the comparative form by graphic charts has proved of great value, for by this method the busy executive can learn what he wants to know at a glance. He can quickly compare the past status with the present, the production against sales, and in an instant can know how the amount of production and sales balance. The accompanying illustration shows an example of a chart used



Example of Chart used in Employment Department

in the employment department and is for illustrative purposes only. In plotting the curves the writer has shown balances that would be obtained only under ideal conditions that every progressive organization strives to attain.

After the chart system is in successful operation it should not ordinarily require more than half an hour to plot in the data each day, and it will more than repay for the work required to keep it up. These charts are made upon coordinate paper which is ruled in light green. The sheets should be perforated and bound in a loose-leaf binder. The writer finds the letter-size sheets to be the most convenient. Where the data pertain to both men and women employes, separate sheets can be used, but they should be so perforated that the two charts will face each other. Daily charts should be placed in the front of the binder followed by the weekly and then the monthly, the yearly charts being placed in the back of the binder.

In the case illustrated, one chart only has been used to record information in regard to men and women employes. Lines drawn upon charts should be standardized as much as possible to avoid misunderstanding. The full line of a color, where there is a dash line of the same color, represents the records of men employes and the dash line represents those of the women. The color key has been developed from railroad signal colors. Green and yellow to a railroad man mean keep moving. The meaning which they express upon the chart is that production is not blocked. Red means stop, and is used upon the charts to represent any element that retards or stops production. Yellow is sometimes used to denote sickness, for lack of another color. Black should be used interchangeably in recording totals. The chart should always state whether it is daily, weekly, or monthly. The unit upon which the scale at the left is based for computing the data should also be shown.

Much confusion in the interpretation of the charts can be eliminated if the key is lettered in the same color ink used for the corresponding lines in the chart. The chart shown is plotted merely as an illustration, but the full set of charts for keeping records of the employment department may consist of five or more similar to the following:

Chart 1—This chart should be similar to the one shown in the accompanying illustration and gives the number of machines idle, operating, and new machines. The yellow line shows the new machines added; the red line, the number of machines idle from lack of operators; and the green line, the number of machines in operation. The total number of machines is recorded by the black line.

Chart 2—This chart shows the status of employes. The full black line represents the total number of men on the payroll and the black dash line, the number of women. The full yellow line shows the number of men sick, and the dash yellow line, the number of women. The number of men present is represented by a full green line and the number of women present, by a green dash line, while the full red line represents the number of men absent, and the dash red line, the number of women absent.

Chart 3—This chart should record the weekly labor conditions. The number of employes discharged should be shown in black lines, and the number leaving voluntarily, in red lines. Green lines should be used to show the number of persons hired. In all cases the full lines refer to men employes and dash lines to women employes.

Chart 4—In this chart is recorded the work of the employment department. It should contain a record of the number of men interviewed, which should be shown by a full yellow line. The number of men hired should be shown with a full green line, while the number of men needed should be shown in a full red line. The same color lines should be used to record the conditions in the womens' employment department.

Chart 5—This chart is of importance in that it shows the attitude of employes toward their work, and is more in the nature of a personal record than any of the other charts described. A record of the number of employes receiving promotion should be shown upon this chart with yellow lines. The number of employes studying for promotion should be shown with green lines, while the number of employes not studying for promotion should be shown in red. Some interesting percentage figures can be obtained by comparing the total number of employes, shown by a black line, with the number of employes studying for promotion as shown by the green line. While the set of charts described forms a complete record for the employment department, variations can, of course, be adopted to meet special requirements.

* * *

The Appellate Court of Indiana has recently confirmed the action of the Industrial Board which granted a compensation to an employe who injured his eye during employment, but who continued to work without reporting the injury at the office until a month later. At the time of the injury the employe told the head electrician under whom he worked and on the evening of the injury consulted the company's physician. The court ruled that since agents and representatives of the employer had knowledge of the injury and since the employe relied upon the opinion of the employer's physician, who declared the injury of no consequence, the employe acted in good faith in not reporting the injury.

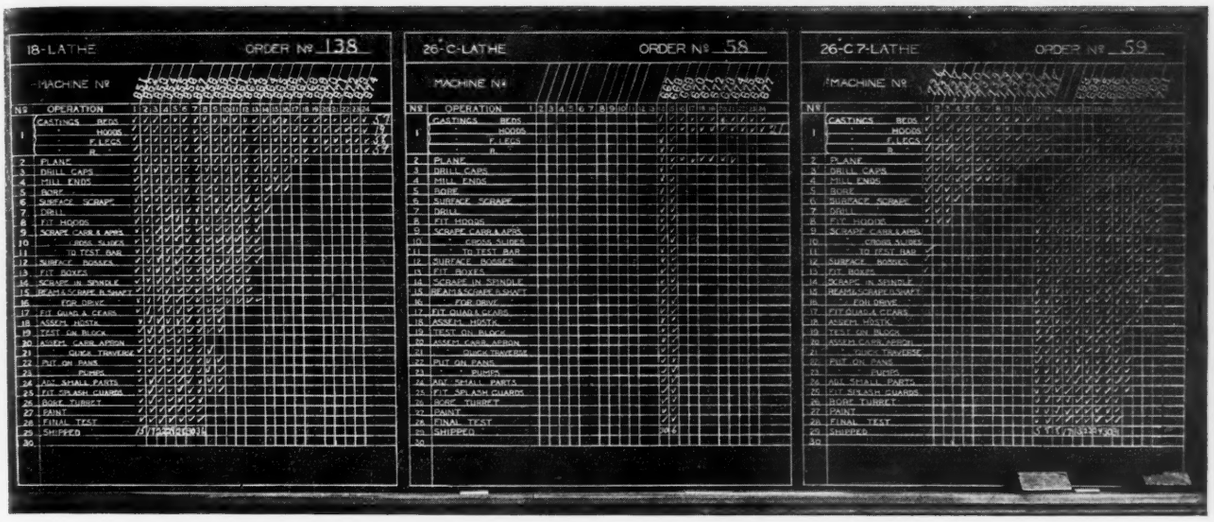


Fig. 1. Record of Progress of Work in Shop

CONVENIENT PRODUCTION RECORD

A simple, but effective, production record used by the International Machine Tool Co., Indianapolis, Ind., is shown by the accompanying illustrations. This record covers all the important operations on parts required in the making of the Libby turret lathes manufactured by the company. The record is kept on large blackboards in the production office. At the top of the record, as indicated in Fig. 1, are given the name and symbol of the machine to be built and the order number on which the machines are completed. Underneath are given the actual manufacturing numbers of the machines; that is, the permanent number under which the individual machine will be recorded. In the left-hand vertical columns are given the numbers and descriptions of the manufacturing operations, and a simple check mark in the columns provided for each individual machine records the progress of the work. In this way, if any one operation is left behind in the general progress of the work, this will immediately be seen on the record. Generally speaking, perfect production would produce a record where a diagonal line drawn from the upper right-hand corner downward would be the boundary line of the check marks.

Referring to the record for the 18-inch lathe in the left-hand part of Fig. 1, it will be seen that operation No. 20, assembling the carriage apron, has not proceeded quite as far as some of the operations below it. In that case, an investigation would be made and any slowing up in the production would be remedied before the parts were required on the assembling floor. The simplicity and effectiveness of the system will readily commend it to anyone who has had to do with methods for recording the progress of production.

Fig. 2 shows a similar blackboard record giving a monthly report of shipments. Here the names of the customers are written to the left, the machine numbers in a column following, and the final important operations are covered by the next six columns. Four columns are provided for dates showing when cars for shipping were ordered, cars received, machines loaded, and cars leaving the plant. The car number is also recorded. In this case, check marks are used when the operations recorded have been completed during the previous month, and actual dates are given when the operations are completed within the present month. A study of the chart indicates, without further explanation, the value of having a record arranged as shown.

— E. O.

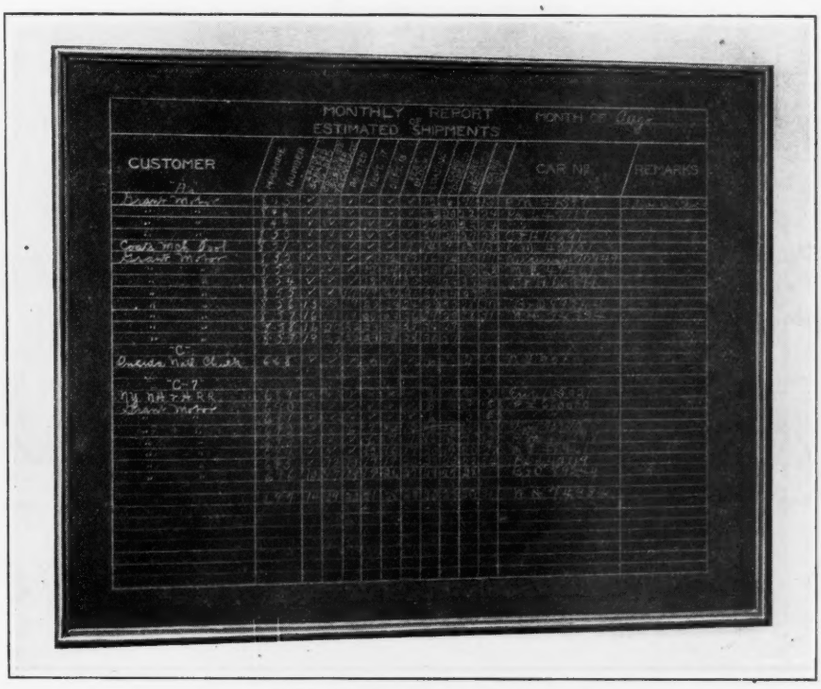
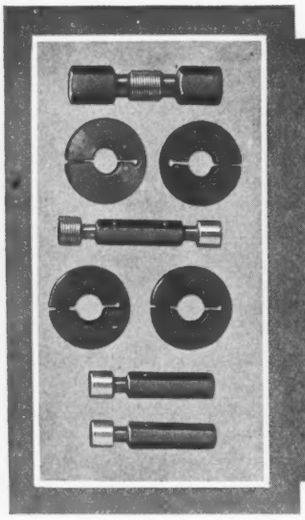


Fig. 2. Monthly Record of Shipments

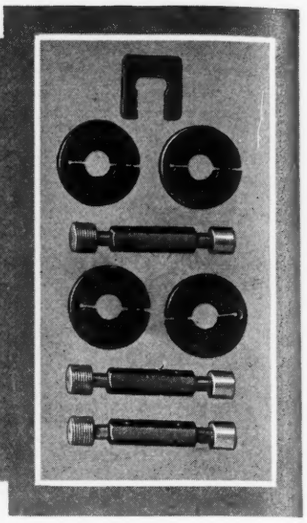
* * *

SUBSTITUTE FOR GASOLINE

A substitute for gasoline has recently been developed, according to *Automotive Industries*, as the result of experiments conducted by Captain E. C. Weisgerber, an oil and gas engineer of the Bureau of Standards. The substitute which is known as Liberty fuel has recently been tested at the Naval Air Station and at Anacostia Flying Field, D. C. Motor truck, airplane, and motorcycle engines were used in making the fuel tests, and in every case the Liberty fuel proved more efficient than the standard grades of gasoline. It is claimed that the cost of manufacture is 40 per cent lower than that of gasoline, and it is stated that arrangements have been completed to commercialize the product and place it on the market. The substitute is described as being scentless, and tasteless. It is further claimed that its products of combustion are cooler than those of gasoline and that they are noncorrosive. It will ignite only from spark or flame, and no special apparatus is required either in the engine or carburetor.



Thread Gages Wing Gages



By Erik Oberg

Last of a Series of Articles Describing Principles Involved and Procedure Followed by the Pratt & Whitney Company in Developing Gaging Systems for Interchangeable Manufacture

THE subject of thread gages is one of the most important in connection with a gaging system. It is not proposed here to go into the details of the making of thread gages, as that subject is entirely beyond the scope of the present series of articles, but simply to describe in detail a thread gage system developed by the Pratt & Whitney Co. for rifle manufacturing outlining the kinds of gages that are provided in the complete set.

Gage Set for Screws

A complete gage set for an external thread or screw is shown in Fig. 1 and consists of:

One soft master plug *A*;

One inspection limit snap gage *B* for the outside diameter of the thread;

One reference gage *C* used as a reference for the inspection gage *B*;

One limit working snap gage *D* used for the outside diameter of the thread;

One maximum inspection thread templet *F* for testing pitch diameter (or, for Whitworth thread, for testing full form);

One minimum inspection thread templet *G* used for testing the pitch diameter;

One maximum reference gage or setting plug *J* for the maximum inspection templet;

One minimum reference gage or setting plug *K* for the minimum inspection templet;

One maximum working thread templet *N* used for testing the pitch diameter (or, for Whitworth thread, for testing the full form);

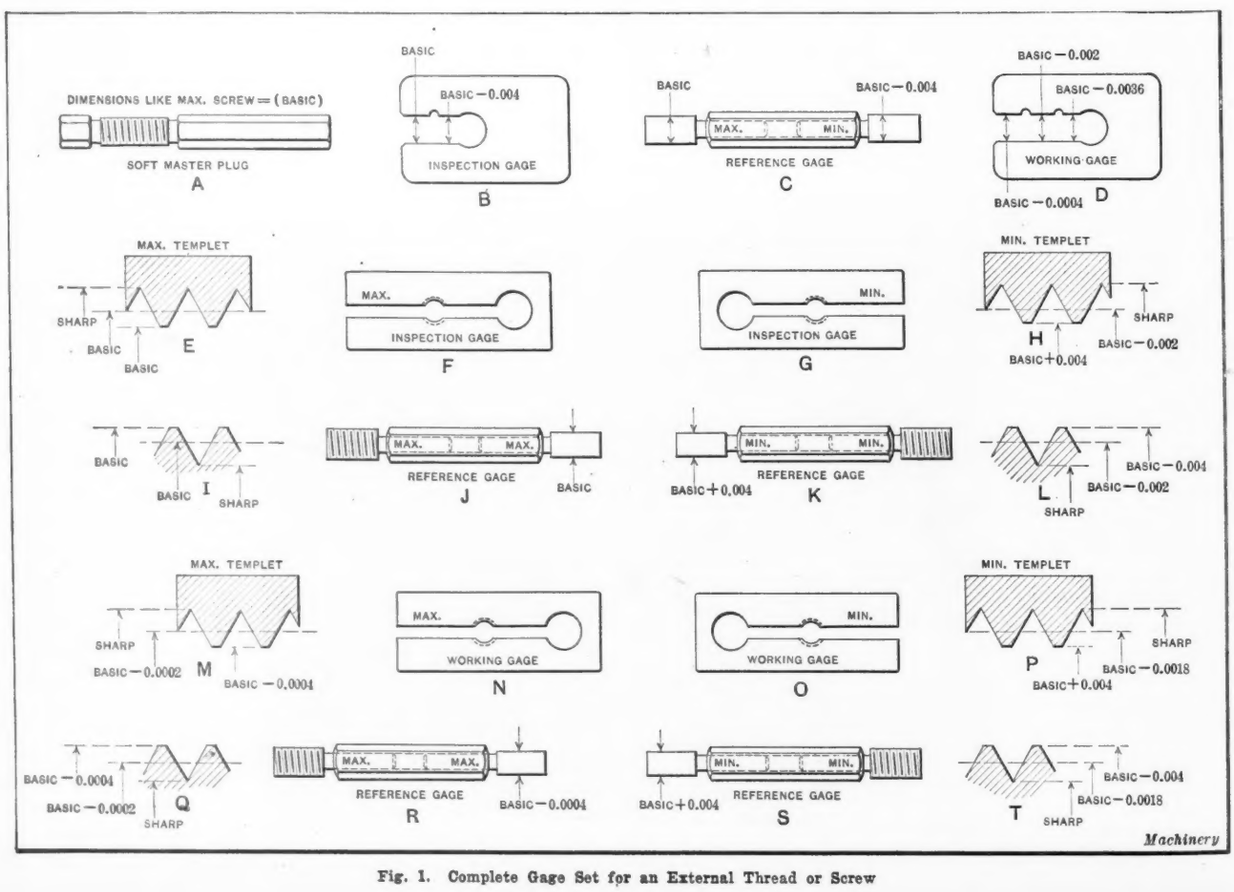


Fig. 1. Complete Gage Set for an External Thread or Screw

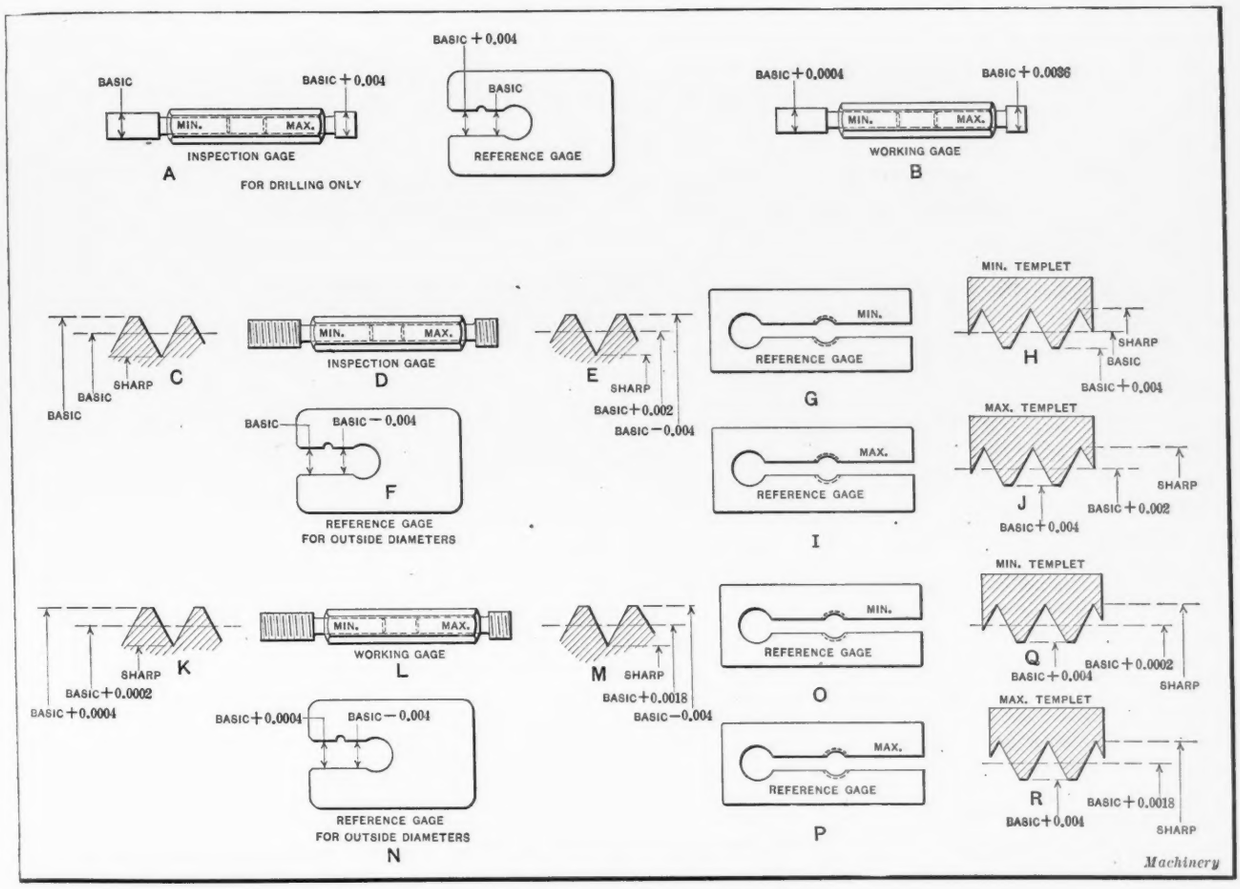


Fig. 2. Complete Gage Set for a Tapped Hole

One minimum working thread templet *O* used for testing the pitch diameter.

One maximum reference gage or setting plug *R* for the maximum working templet;

One minimum reference gage or setting plug *S* for the minimum working templet.

This constitutes the complete set of gages required for a screw. The soft master plug is made to the basic size of the screw which is also the maximum screw size. This master plug is the ultimate reference for the whole set of thread gages. It is not intended for general use in connection with the gaging of the product, but only for the re-establishing of the worn reference gages *J*, *K*, *R*, and *S*. The soft master plug is not even intended to be screwed into a hole, as this would cause wear, and for that reason it is provided with hexagon ends larger than the outside thread diameter. This construction also protects the thread when the master plug is laid down upon a bench or machine table. The master plug is used as an ultimate reference gage for the other gages in the set only by using comparative measurements, a thread micrometer or ball micrometer being used for transferring the measurements from the master plug to the thread gages.

It will be noted that in Fig. 1 enlarged views of the thread forms of the various templets and gages are shown in conjunction with the gages themselves, the thread form at *E* being for the inspection gage *F*; that at *H* for the inspection gage *G*; that at *I* for the reference gage *J*; and that at *L* for the reference gage *K*. In the same way the thread forms at *M*, *P*, *Q*, and *T* are for the working and reference gages *N*, *O*, *R*, and *S*, respectively. It will be noted that dimensions are given in connection with some of these, and also in connection with some of the gages. These dimensions are based upon the practice of the Pratt & Whitney Co. and cover gages intended for the U. S. standard and Whitworth form of threads from 20 to 50 threads per inch, these being the number of threads required in connection with small arms work. These

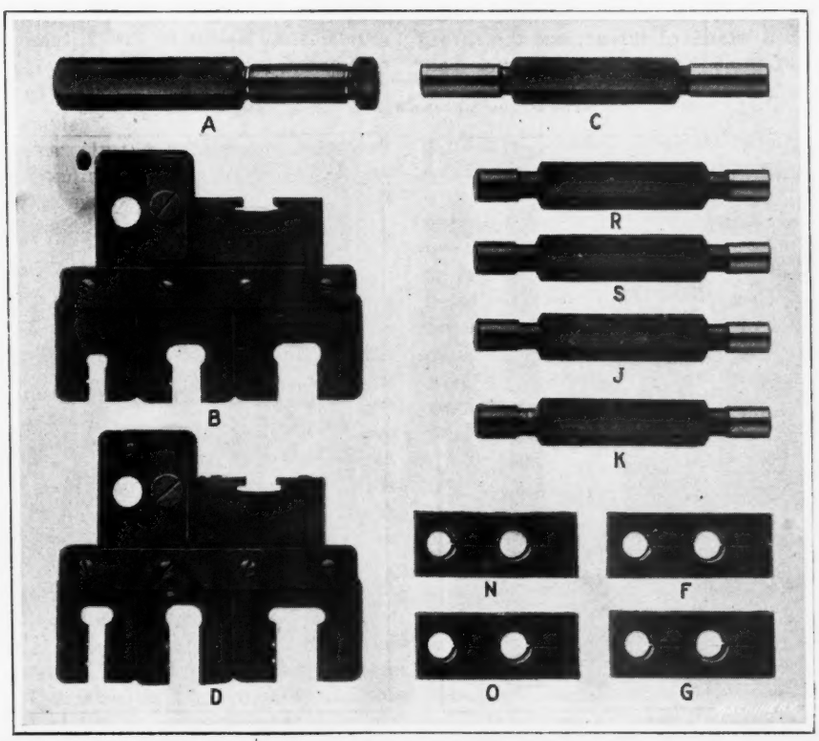


Fig. 3. Complete Gage Set for a Screw, corresponding to that shown in Fig. 1

dimensions agree with those given in the table "Tolerances for Tapped Holes and Screws" on page 107 of the October number of MACHINERY.

Complete Gage Set for Tapped Holes

A complete gage set as furnished by the Pratt & Whitney Co. for tapped holes is shown in Figs. 2 and 4. This consists of the following:

One maximum and minimum inspection plain plug gage *A* for the diameter of the plain drilled hole which is to be tapped;

One reference gage for inspection gage *A*;

One maximum and minimum working plain plug gage *B* for the diameter of the plain drilled hole to be tapped;

One maximum and minimum inspection thread gage *D* for the pitch diameter of the threaded hole (or, for Whitworth thread, for testing the full form);

One reference gage *F* for the outside diameters of the maximum and minimum ends of inspection gage *D*;

One minimum reference gage *G* for the minimum thread plug of inspection gage *D*;

One maximum reference gage *I* for the maximum thread plug of inspection gage *D*;

One maximum and minimum working thread gage *L* for the pitch diameter of the threaded hole (or, for Whitworth thread, for testing the full form);

One reference gage *N* for the outside diameters of the maximum and minimum ends of working gage *L*;

One minimum reference gage *O* for the minimum thread plug of working gage *L*;

One maximum reference gage *P* for the maximum thread plug of working gage *L*.

It will be noted that the gages shown both in Fig. 1 and in Fig. 2 are for the U. S. standard thread, but the thread is made sharp in the bottom of the groove in all cases, both for templets and plugs. The form of the thread and the tolerances for the various templets and plug gages are shown in conjunction with the gages in Fig. 2, the same as in Fig. 1; thus, *C* is the thread shape for the minimum inspection gage *D*; *E*, for the maximum inspection gage *D*; *H*, for the minimum reference templet *G*; *J*, for the maximum reference templet *I*; and similarly for the working gages.

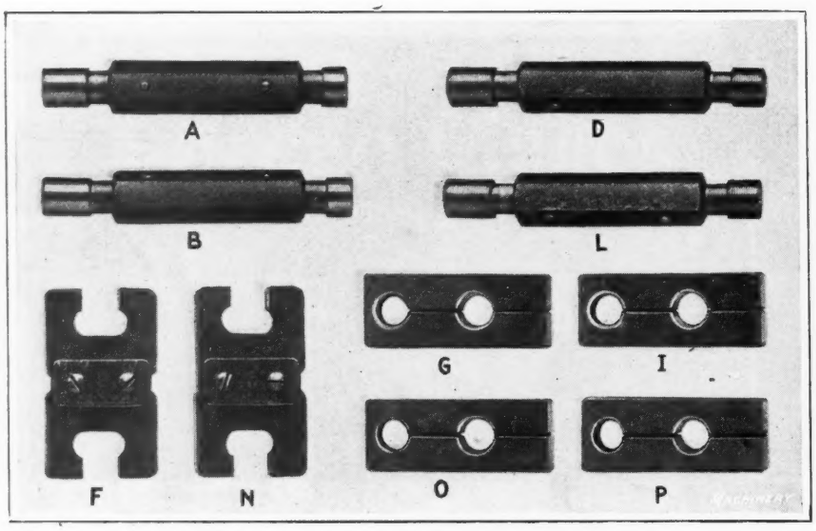


Fig. 4. Complete Gage Set for a Hole, corresponding to that shown in Fig. 2

In all cases the adjusting screws in the outer ends of the templets are not shown, as it is not the intention to show the specific construction of the gages, but merely to indicate what constitutes a set of gages and the tolerances to which they are made.

Illustrations of a Gage Set

Fig. 3 shows a set of gages such as is made by the Pratt & Whitney Co. for its customers. At *A* is shown the soft master plug corresponding to plug *A*, Fig. 1; *B* shows the inspection snap gage for the outside diameter of the thread, corresponding to gage *B*, Fig. 1; *D* shows the working snap gage for the outside diameter of the thread, corresponding to the snap gage *D*, Fig. 1. These two snap gages are held with other gages in the standard snap gage holder used by the company. It will be noted that the gage *B*, being the inspection gage, has only two steps, while gage *D*, being the working gage, has three steps, maximum, mean, and minimum. At *C* is shown the reference gage for inspection gage *B*, corresponding to gage *C*, Fig. 1. In the same way, gages *F* and *G*, Fig. 3, correspond to inspection gages *F* and *G*, Fig. 1, and gages *N* and *O* in both figures are also the same. The reference gages, *J*, *K*, *R*, and *S*, are also lettered the same in both illustrations.

In Fig. 4 are shown the gages that correspond to the diagrammatical lay-out in Fig. 2, these gages being lettered to correspond in both illustrations. The reference gages *F* and *N* are not made with two steps in Fig. 4, as indicated in

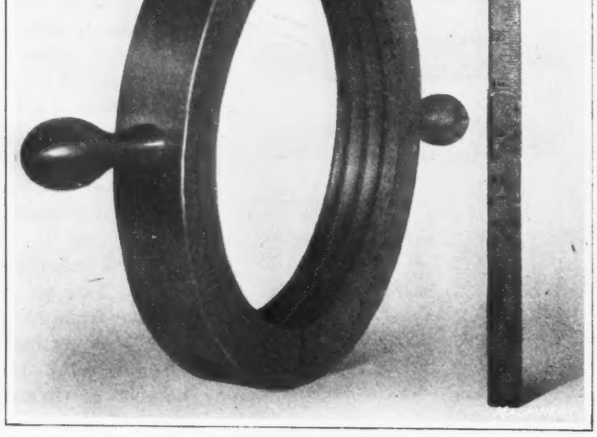


Fig. 5. An Internal Thread Gage of Large Size which is provided with Handles

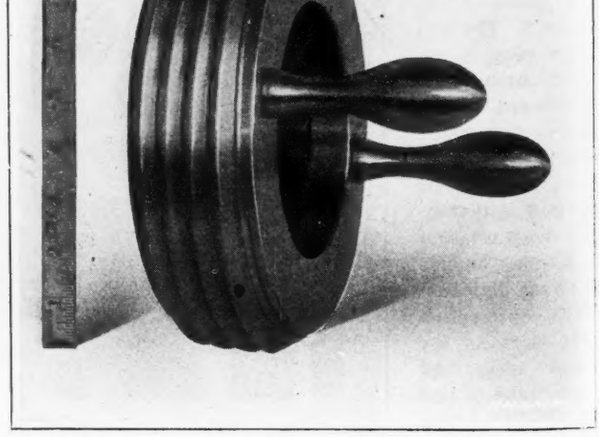


Fig. 6. An External Thread Gage in the Form of a Ring, provided with Handles

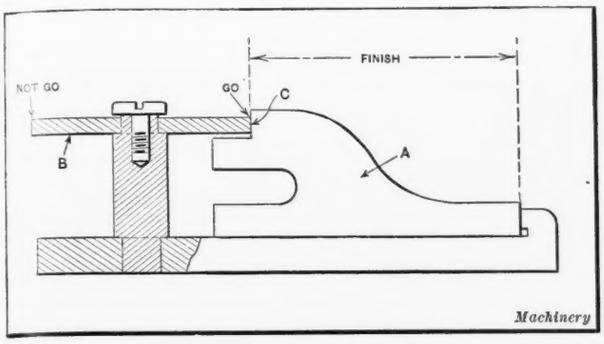


Fig. 7. Principle of Windmill or Wing Gage

Fig. 2, but in the case shown in Fig. 4, separate snaps are made for the maximum and minimum sizes.

Special Forms of Thread Gages

When the thread gages become very large, it is customary to use round forms instead of the templet forms shown in the preceding illustrations. Fig. 5 shows an example of this kind, in which handles are provided on the gage for convenience. The gage is provided with adjustment as indicated by the adjusting screw and split in the lower part of the illustration. A similar large external thread gage which is also provided with handles, is shown in Fig. 6. It is evident that it would be difficult to handle large plugs of this size if they were not constructed in a special manner as indicated. By boring out the center of the plug, the gage is made much lighter, and by eliminating the solid handle and instead using two ordinary handwheel handles, as indicated, the gage is much more convenient to use.

Special types of thread gages sometimes used are known as "qualifying" thread gages. These are employed when the thread must be cut in a certain position relative to a shoulder, as for example in a rifle barrel and receiver. In this case, lines are scribed on the gage and a corresponding zero line is scribed on the work. The gage is then screwed home into the work until the lines check with each other.

Windmill or Wing Gages

Windmill or wing gages are used in some instances where snap gages cannot be conveniently applied to the work. The name is derived from the fact that the gage is provided with some kind of swinging member or wing, resembling, in some instances, the wings of a windmill. These gages are limit gages, and the principle is simply that one wing will pass by the work while the other wing will not. Fig. 7 shows, in diagrammatical form, a simple case where a gage of this kind would be applied. The part *A* is to be gaged, and the length marked "finish" is the distance that is required to be within certain limits. It is evident that it is not convenient to apply a snap gage to a piece of this shape; hence, a gage having a swinging member *B* is used. One end of this member will pass by the work at *C*, while the other end will not. In this way the work can be very rapidly and accurately gaged. Fig. 9 shows a practical application of this type of gage. Here the swinging member does not swing clear around, but merely has two surfaces *A* and *B*, one of which will pass by, and one of which will not pass by, the end of the work when it is inserted into the gage.

Fig. 8 shows a more elaborate type of this kind of gage, the design of which is also shown in Fig. 10. This gage is provided with a swinging member *A* and gages the depth and width of a slot in a piece of work. One end of the gage must pass through and one must not pass through the slot in order to determine the depth of the slot. At *B* is provided an ejector for the work with an eccentric on one end of a stud which pushes the work out of position. Fig. 8 shows the work in position and indicates how the gage works. The "Go" end of the swinging member used for measuring the depth of the slot is here shown in position for measuring the thickness of the side of the piece on one side of the slot. This end of the swinging member is provided with a projection on one side which bears against the side of the slot, and the end of the block *C* is provided at *D* with steps as in the case of a flush-pin gage, by means of which it may be determined whether the thickness of the work at *E* is made to the required tolerance.

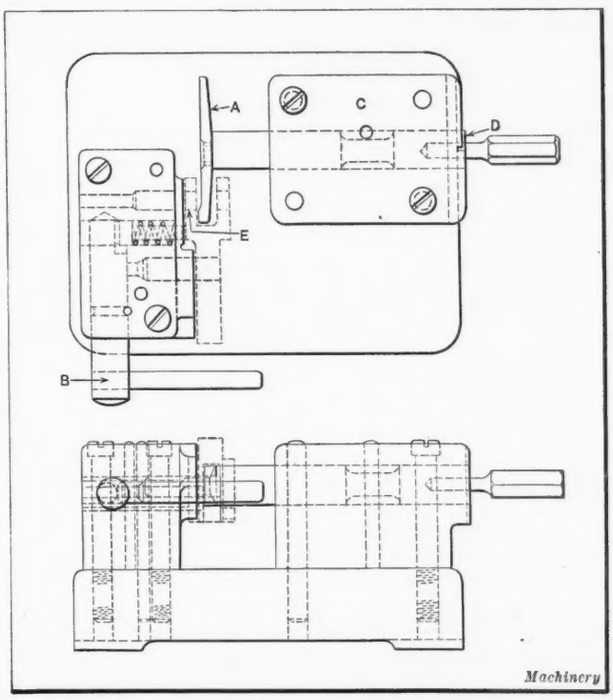


Fig. 8. Design of a Windmill Gaging Fixture

Fig. 11 illustrates another application of the wing gage, showing how it may be arranged to be held on a small plate and built up together with other gages in a standard snap-gage holder. The principle of this gage is the same as of those previously mentioned, in that one end will pass by the work while the other end will not, if the work is made to the required limits.

Functional Gages or Dummy Mechanisms

Figs. 12 and 13 show an interesting example of what is known as a functional gage or dummy mechanism. Fig. 12 shows the dummy mechanism opened, while Fig. 13 shows it closed. The device is a duplicate of the breech mechanism of a large gun, and is used for gaging the various parts of the breech mechanism. When used as a gage, the component parts are removed from the dummy mechanism and the actual parts to be gaged are substituted. It is evident that if the working parts substituted fit in the dummy mechanism properly they will be satisfactory and can be used in the interchangeable assembly of guns. The dummy mechanism, or functional gage, as it is also called, must of course be made very carefully to extremely close limits, and should preferably be made to maximum metal dimensions throughout. This latter requirement is preferably for a functional gage, as it will absolutely assure that any part that will work or enter the dummy mechanism will also function properly when assembled in the finished gun. For large

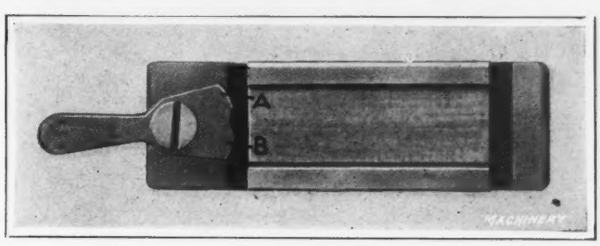


Fig. 9. A Simple Example of Windmill Gage

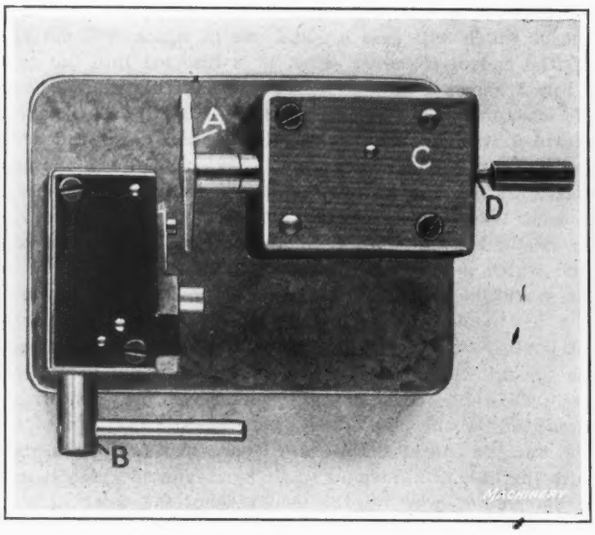


Fig. 10. Gaging Fixture, the Design of which is shown in Fig. 8

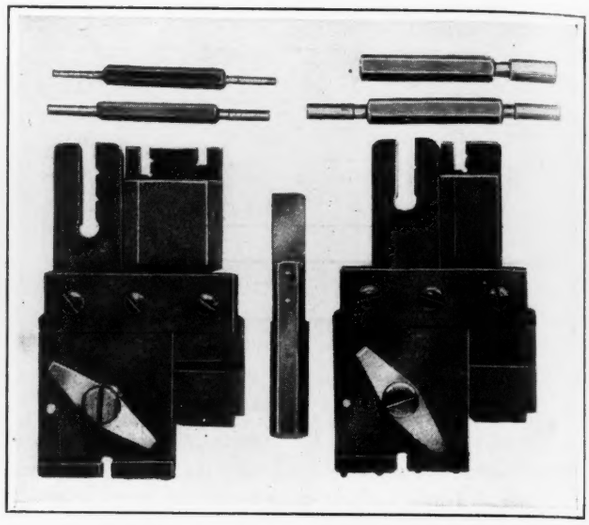


Fig. 11. Wing Gage used in Conjunction with Snap Gages

pieces of work where ordinary gages would be heavy and cumbersome, the functional gages offer a satisfactory means of gaging; and in addition, it is considered very valuable because of the assurance it gives that the parts can be properly assembled. The instances where functional gages can be applied are numerous. Sometimes, of course, slight changes from the actual design of the mechanism itself may be required in order to simplify the methods by which the work to be tested in the gage may be inserted or removed. On the whole, however, the functional gage should be a duplicate of the actual mechanism at least in so far as the design of those component parts that are required to fit each other is concerned.

This article completes the series begun in October MACHINERY on the development of gaging systems and on the design of various types of gages.

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TESTING AUTOMOBILE SPRINGS

In a paper read before the Steel Treating Research Society, Detroit, Mich., on the heat-treatment of automobile springs, M. E. Hendrickson of the Mather Spring Co., Toledo, Ohio, states that spring steels may be tested by the same methods that are used in the testing of other steels, but the tensile test is not always satisfactory since it is difficult to obtain pure tension without bending in the thin plate specimens, as the sections are never thick enough to be machined to the standard ½-inch test specimen. However, a transverse test has been developed which gives very satisfactory results in determining the elastic limit. This may be performed in the Brinell machine by mounting on the anvil a suitable cross-piece with V-supports about 10 inches apart. The load required to cause a permanent set may then be determined and the stress due to such load calculated by the regular beam formulas.

Another means of transverse testing may be developed from the principle that the modulus of elasticity of steels is practically constant or varies only from 28,000,000 pounds to 30,000,000 pounds per square inch. Therefore it is evident that the stress in a bar is proportionate to its deflection, and if a suitable apparatus be made for giving predetermined deflections gradually increasing them until permanent set occurs, it is possible to obtain a close approximation of the elastic limit. For example, suppose that steel ¼ inch thick, placed on V-blocks 10 inches apart, deflects 0.403 inch just before taking permanent set and at the next trial with 0.024 inch more deflection it does take permanent set; the stress in the first case, assuming the modulus of elasticity to be 29,000,000 pounds per square inch, is 190,000 pounds per square inch; and in the second case it is

$$\frac{0.427}{0.403} \times 190{,}000 = 200{,}000 \text{ pounds, approximately}$$

It is evident that the transverse elastic limit or yield point is somewhere between these two stresses, and the increments of deflection may be made as small as desired. An electrical contact point may be adjusted so that when the material settles, the circuit will not be completed, which will cause a light to go out, thus indicating that the elastic limit has been exceeded.

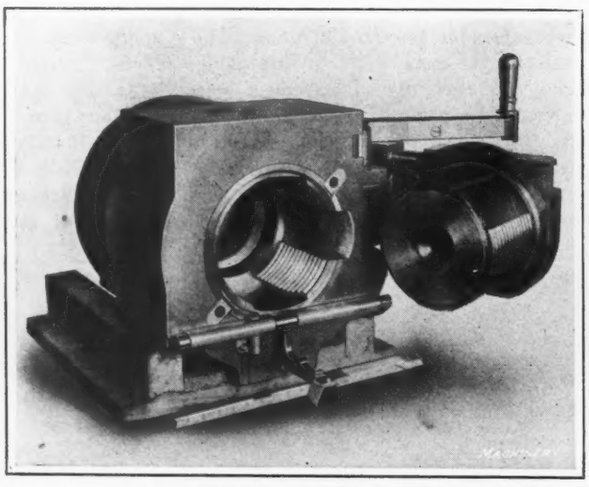


Fig. 12. Functional Gage for Breech Mechanism of a Large Gun

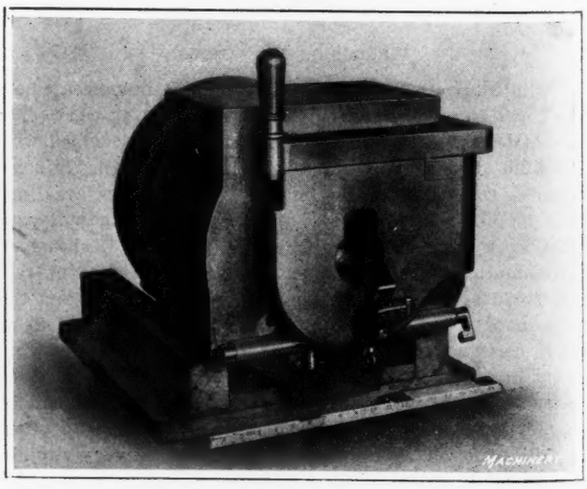


Fig. 13. Breech Mechanism Dummy Gage, shown in Fig. 12, Closed

Cylinder Boring and Reaming Tools

Types and Designs of Cutter-heads and Reamers Used for Rough-boring and Reaming Small Engine Cylinders—By Franklin D. Jones

THE boring and reaming tools used by different manufacturers for roughing and finishing the cylinders of automobile engines and other comparatively small cylinders differ considerably both in regard to their design and in the method of applying the tools. The variations in practice are due, in part, to the fact that some manufacturers prefer to finish the cylinder bores by a cutting or reaming tool, whereas others prefer to obtain the final finish by grinding. Aside from the type or design of tool used, the practice varies in the number of cuts which are considered necessary either for completely finishing cylinder bores or for machining them close enough to the required size for a final grinding operation. As the results obtained in connection with boring and reaming practice may depend largely upon the cutting tools used, various designs which have been employed successfully will be described.

In referring to the designs illustrated, it will be noted that they differ principally in regard to the number of cutting blades, the position of the blades and the method of holding and adjusting them. The number of blades on tools of this class ordinarily varies from two to eight, although some finishing reamers have twelve blades. In some plants two-bladed tools are used for both roughing and finishing, whereas in others a finishing reamer having at least from four to six blades is considered preferable for both roughing and finishing cuts. The finishing reamer usually has a floating movement, although some manufacturers contend that better results are obtained by using a rigid or fixed tool for both the roughing and finishing cuts. The different types of tools to be described will serve to illustrate some of the more important variations in practice as applied to boring and reaming tools for cylinder work, especially in automobile factories.

Six-blade Cutter-heads for Rough-boring Cylinders

The cylinder bores of Cadillac motors are finished by boring, reaming, and grinding. The rough cylinders are cored to 2⅞ inches in diameter, and the final size is 3⅛ inches. The rough-boring tool shown in Fig. 1 enlarges the bore to about 3 1/32 inches. This roughing cut is followed by two light semi-finishing cuts, and then the bore is finished by grinding. The roughing cutter has six blades which are set at an angle of 10 degrees with the axis and at an angle of 3 degrees from a radial position, to provide rake. The cutter blades are, of course, of high-speed steel, and the body, of 0.40 per cent carbon steel, packhardened.

The method of holding the cutter blades in position differs somewhat from the usual arrangement. There are 1/16-inch slots in the body of the tool between the blades or cutter slots, and taper pins are used to hold each cutter firmly in place. This construction is considered better than using a flattened taper pin which bears directly against the side of the cutter. With the method illustrated in Fig. 1, each cutter blade has a full bearing on both sides and is held more securely than when one side bears against a pin. The end of the cutter body is bored out to a diameter of 1⅜ inch and to a depth of 1 inch to secure greater flexibility for the sections which are expanded by the taper pins. A tool-steel block *A* is inserted in this hole to provide a backing or support for the cutter blades. This block is held in position by a ⅜-inch fillister-head screw. The cutter blades have a land 1/32 inch wide.

The tongue at the base of the shank for driving the cutter has radial driving surfaces at *B* and *C*. The object of locating the driving surfaces in a radial position is to change the direction of the thrust on the slotted end of the machine spindle. When the driving faces are radial, there is less tendency for the slotted end of the spindle (which receives the tongue) to spread when subjected to heavy stresses, because the thrust is more nearly in line with the solid section of the spindle. The semi-finishing cutters are practically the same as the type used for roughing, except that the blades are held parallel with the axis instead of being inclined.

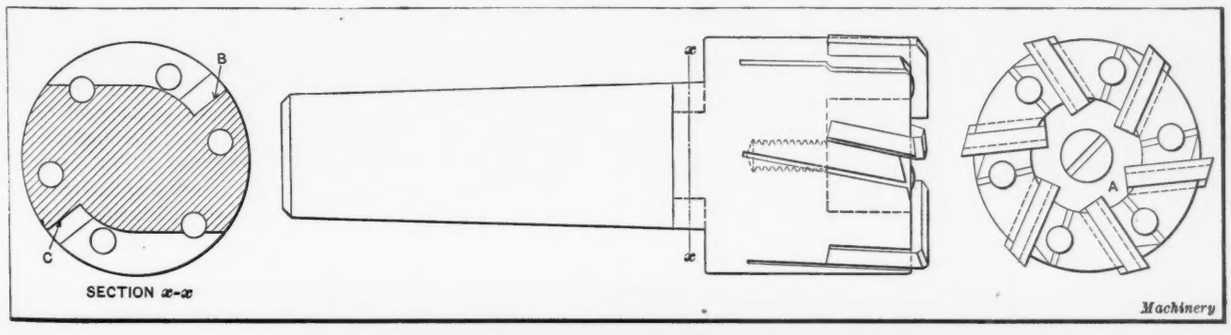


Fig. 1. Six-blade Rough-boring Cutter having Radial Type of Driving Tongue

The Continental Motors Corporation, Detroit, Mich., uses three boring or reaming tools, but the cylinders are finally finished by grinding, as this is considered the only practicable method of securing the desired accuracy in quantity production. The tool illustrated in Fig. 2 is used for the first and second rough-boring operations. There are six blades or cutters, and these are located at an angle of 10 degrees to give the required rake. The finishing reamer which follows the two roughing cuts leaves the bore from 0.006 to 0.008 inch under size for grinding. These tools are provided with a tongue 1¾ inch wide just back of the cutter body, which engages a slot in the machine spindle and provides a positive drive. The cutters are held in place by pins flattened on one side to an angle of 3 degrees.

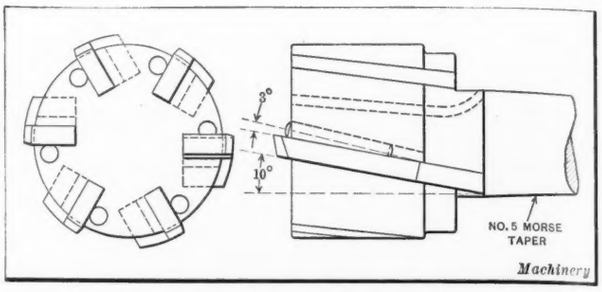


Fig. 2. Another Design of Six-blade Roughing Cutter

Six-blade Tool Followed by Two-blade Type to Straighten Bore

Two designs of cylinder reamers used by the Rutenber Motor Co., Marion, Ind., are shown in Fig. 4. The cylinders are first rough-bored with a six-blade tool of the type shown at *A*. This tool is followed by the two-blade design illustrated at *B*, and then another six-blade tool is used and the cylinders are finally finished by grinding. The object of using the two-blade tool is to straighten the bore. If the tool used for the first roughing cut is deflected laterally owing to unequal distribution of the metal in the cored hole, it is claimed that the two-blade tool will straighten the bore, because it is less likely to be deflected and tends to finish the bore more nearly in alignment with the machine spindle. The six-blade tool is then used prior to grinding, the claim being that it finishes the hole more smoothly than a two-blade tool and also produces a perfectly round hole, thus making it possible to finish the bore close to the grinding size. The blades of the tools illustrated in Fig. 4 are set at an angle of 7 degrees, and they are held in position by 5/16-inch pins flattened on the side. The bottoms of the slots for the blades are milled to an angle of 3 degrees to provide for radial adjustment. The diameter of the first roughing tool is 3 inches. The hole is then enlarged to 3.070 inches by the two-blade tool, after which it is further enlarged to 3.114 inches by the final boring tool, the last operation bringing it to within 0.011 inch of the finished size, which is 3.125 inches.

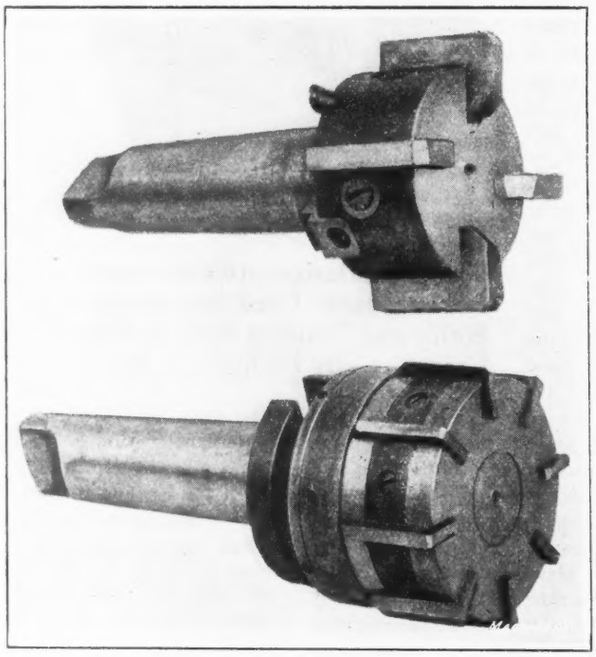


Fig. 3. Four-blade Rougher and Eight-blade Reamer for machining Cylinders before grinding

Four-blade Rougher Followed by Eight-blade Reamer

The types of tools used by the White Co., Cleveland, Ohio, for machining cylinder bores prior to grinding are illustrated in Fig. 3. For rough-boring, the four-blade boring tool seen in the upper part of the illustration is used. After a number of cylinders have been bored, the first roughing cutters are replaced by eight-blade reamers of the design shown in the lower part of the illustration. The cylinders are then reamed on the same machine prior to grinding.

Six-blade Roughing Tool Followed by Eight-blade Reamer

At the plant of the Reo Motor Car Co., Lansing, Mich., the cylinders are rough-bored and reamed and are then finished by grinding. The first rough-boring tool is followed by a second roughing tool and then a light cut is taken by a third tool prior to grinding. The tool used for the first rough-boring operation is shown at *A*, Fig. 5. This tool has six high-speed steel blades, and each blade is held in place by three machine screws, the heads of which engage shoulders formed on the side of the blade. The cutter-head is mounted upon an extension of the arbor, and is held in place by a washer and countersunk screw. A ⅝-inch slot on each side of the cutter-head at the rear engages a key. These two keys are fitted to ¾-inch slots in the arbor flange, and each key is held in place by two screws. The keys project beyond the flange far enough to form a tongue for engaging a cross-slot in the machine spindle. The shank of the arbor is a No. 5 Morse taper. The tool used for the second roughing cut is practically the same as the one just described, except that it is a little larger in diameter. The eight-blade tool *B* finally used before grinding is also similar in construction to the other tools as far as the method of holding the cutter blades and arrangement of the driving keys is concerned. This tool, which is used for the final reaming operation, is held rigidly to the arbor instead of giving it a slight floating movement, which is commonly done with reamers used to finish cylinder bores without a grinding operation. Tool *A* rough-bores the cylinder to 4.658 inches; the second rough-boring tool enlarges the bore to about 4.708 inches; and the third tool removes 0.030 inch, leaving the bore approximately 4.738 inches or within 0.012 inch of the required size.

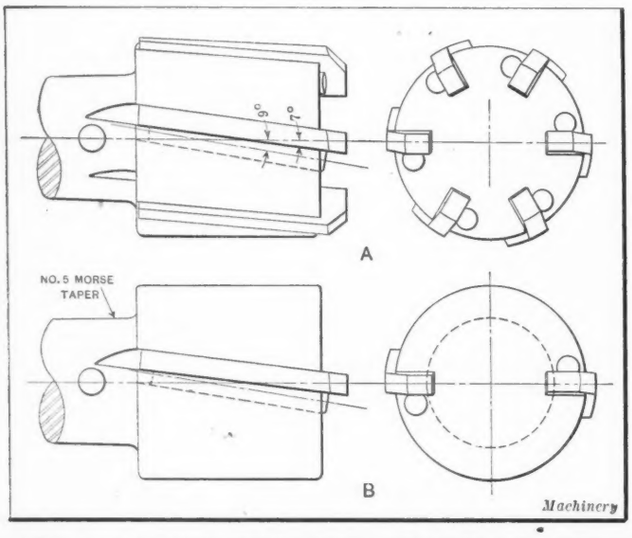


Fig. 4. (A) Six-blade Roughing Cutter. (B) Two-blade Tool which follows the Roughing Cutter to straighten the Bore

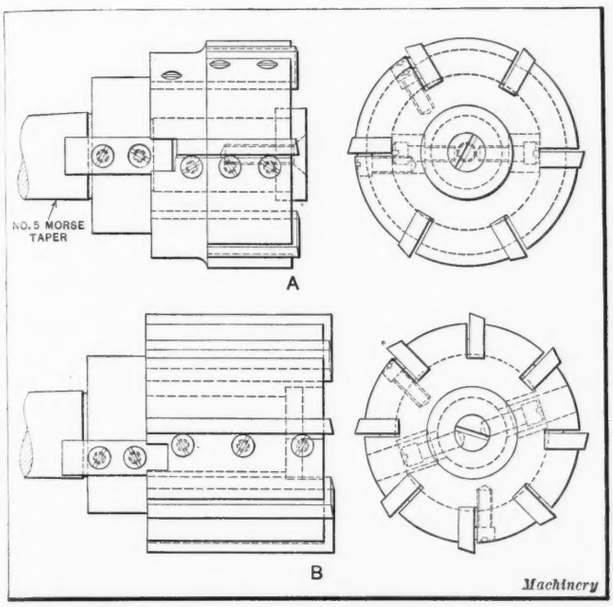


Fig. 5. (A) Roughing Cutter. (B) Eight-blade Tool used before Grinding Operation

Adjustable Rough-boring Tool and Floating Finishing Reamer

Cylinder boring and reaming tools which have proved very successful as applied to the cylinders of motors for one of the comparatively expensive automobiles are shown in Fig. 6. With this tool equipment it is claimed that cylinders can be reamed to within 0.00025 inch of being straight and round, and that the production, as compared with grinding, is in the ratio of 4 to 1. The first roughing tool used is shown at *A*. This tool is used on a horizontal Beaman & Smith four-spindle machine, and the holes are rough-bored to 3⅛ inches in diameter. The four high-speed steel cutters are made of ½-inch square stock and are held at an angle of 45 degrees. They are adjusted for varying the diameter by means of a central plug which is screwed in or out, thus changing the position of the conical seat against which the ends of the cutters bear. The clamping screws for holding the cutters in position are clearly shown in the illustration. This tool has a No. 5 Morse taper shank which enters a socket or holder having at the opposite end a flange which is bolted to the machine spindle. The holder is equipped with two cutters which serve to chamfer the crank-end of the cylinder so that the piston packing rings will enter more readily. These cutters are attached to the holder in such a position that they come into action when the rough-boring tool has reached the end of its cut.

Two semi-finishing cuts are next taken on a twelve-spindle Beaman & Smith machine of the same type as is illustrated in Fig. 6 of the article entitled "Cylinder Boring and Reaming," published in the January number of MACHINERY. This machine is equipped with tools of the type shown at *B*, Fig. 6. The bore is first enlarged from 3⅛ inches to 3 3/16 inches with one group of spindles. Then the work-table is revolved to locate the casting under the second group of spindles, after which a third cut is taken, which increases the size to 3.240 inches. The tool used for the second and third cuts, like the first roughing tool, is adjustable for size. The adjustment is obtained by loosening the blades and turning the threaded collars at the rear. The collar adjacent to the blade has a 30-degree taper to correspond with the blade ends, and the slots in the body of the cutter have an inclination of 7 degrees, which provides the necessary radial adjustment. The blades are clamped by screws and hardened bushings flattened on one side to an angle of 3 degrees.

The finishing reamer, which enlarges the bore to 3.250 inches is shown at *C*, Fig. 6. This tool has eight high-speed steel blades which are held in place by pins having tapering flat sides. The cutter-head is mounted on an extension *d* of the reamer-bar, and it is driven by an intermediate plate *e* having tongues on each side located at right angles to each other like an Oldham coupling. The bore of the cutter-head is 1 inch and the diameter of the extension *d* is 0.995 inch, so that the cutter-head is free to float laterally 0.005 inch at this point. This universal floating movement is made possible by the Oldham coupling type of drive. The reamer-bar also has a floating connection to the shank. The extension *f* on the shank is ground to a radius of 3¼ inches, and the connecting pin passes through a hole which fits the pin only at the center as the illustration shows. This final

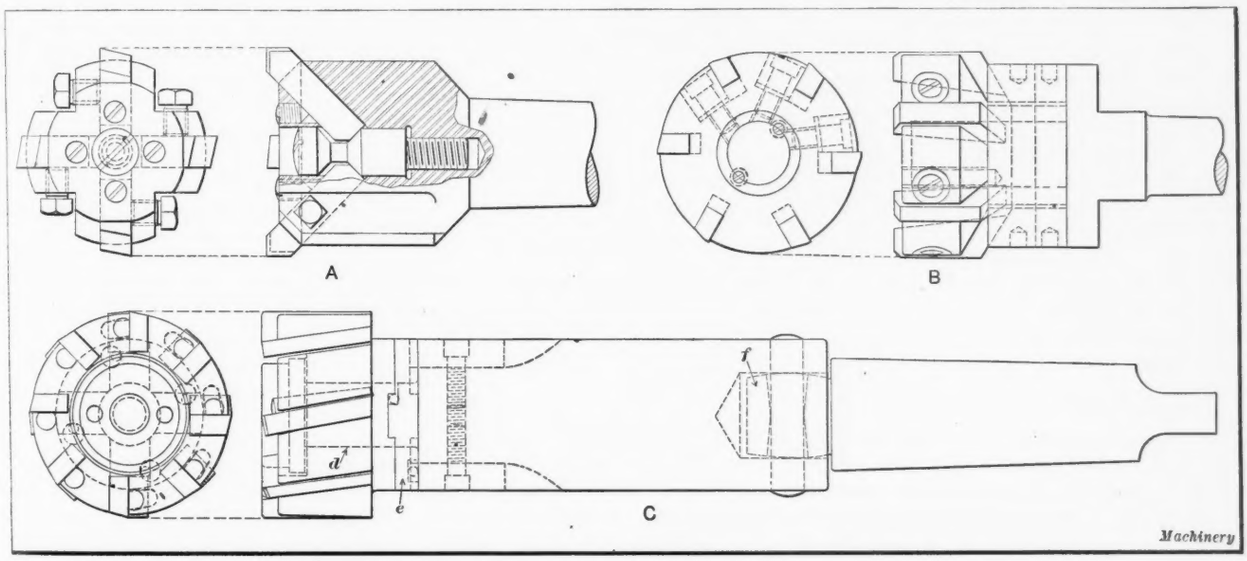


Fig. 6. (A) Adjustable Roughing Tool. (B) Tool for Semi-finishing Cuts. (C) Floating Finishing Reamer

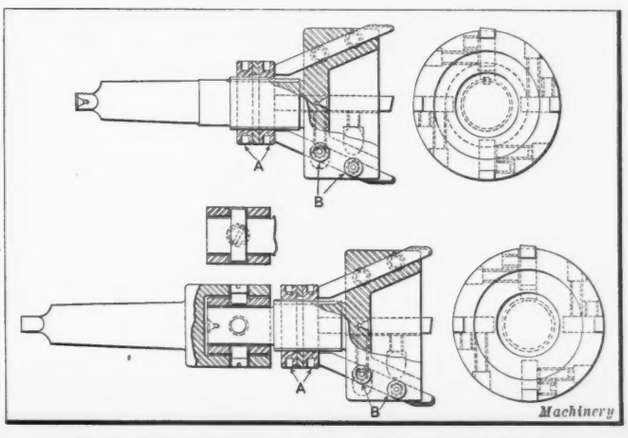


Fig. 7. Adjustable Cutter-heads of Rigid and Floating Types

reaming operation is done on a vertical single-spindle machine, which is considered superior to a multiple-spindle type for this particular operation. The feed for reaming is 0.016 inch per revolution, and the speed, 26 revolutions per minute, which is equivalent to a peripheral speed of 22 feet per minute. The blades of the finishing reamer are inclined 10 degrees relative to the axis in such a way as to form a left-hand spiral. The reamer was made in this way to prevent chattering and to secure smoother reamed surfaces.

Adjustable Cutter-heads of Rigid and Floating Types

The roughing and finishing cutter-heads shown in Fig. 7 are designed to bore cylinders varying from 6 to 7 inches in diameter. Each tool has four cutters which are held in place by set-screws *B* and also by collars *A*. These collars are threaded to the body of the tool and provide means of adjustment as well as a firm backing for the cutters. The tool shown in the upper part of the illustration is used for roughing and is a rigid design, whereas the lower tool is used for finishing and has a floating connection between the shank and the cutter body. The arrangement of this floating connection is clearly shown by the two sectional views.

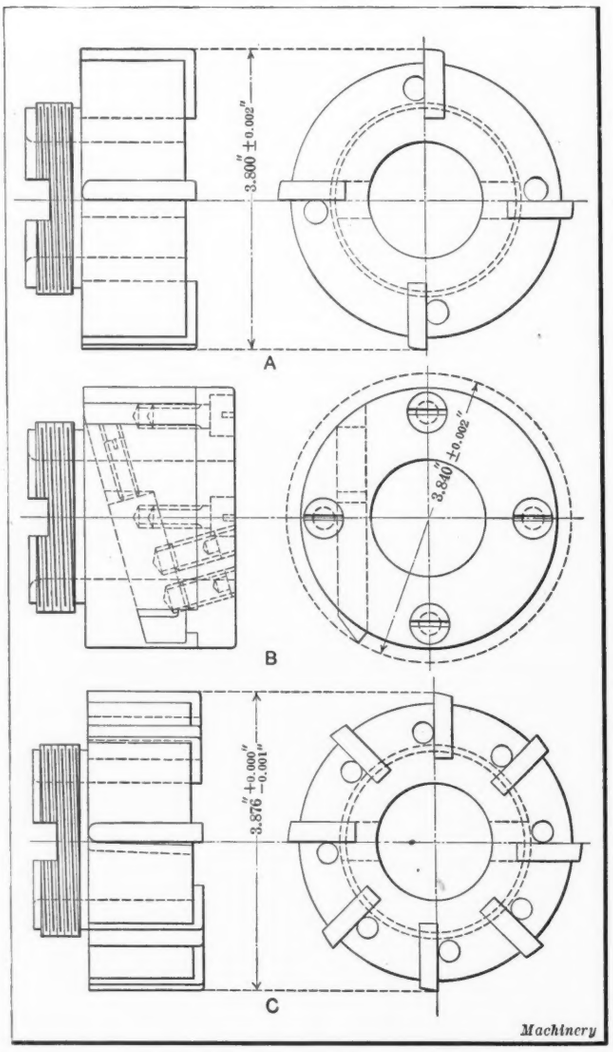


Fig. 8. (A) First Roughing Cutter. (B) Single-point Tool which follows Roughing Cutter. (C) Eight-blade Finishing Reamer

Use of a Single-point Tool in Connection with Reamers

A single-point boring tool is used for rough-straightening the cylinder bores before reaming, at the plant of the Wilcox Motor & Mfg. Co., Saginaw, Mich. The order of operations is as follows: First operation, rough-boring with a four-blade tool; second operation, rough-straightening the bore with a single-point tool; third operation, rough-reaming with a four-blade tool; fourth operation, finish-reaming with an eight-blade reamer. The first rough-boring tool or "reamer" is illustrated at *A*, Fig. 8. The diameter of this reamer is 3.800 inches, plus or minus 0.002 inch. The cutters are held in place by 5/16-inch carburized and hardened pins flattened on one side to an angle of 3 degrees. The cylinder bore is enlarged by the single-point tool *B* to 3.840 inches, plus or minus 0.002 inch. This tool is held at one side of the tool-head, as shown by the end view, and the tool slot has an inclination of 15 degrees. The single-point tool is followed by a second roughing reamer, which is practically the same as the design shown at *A*, except that the diameter across the blades is 3.863 inches, plus or minus 0.001 inch. The finishing reamer *C* has eight blades and a diameter of 3.876 inches, plus 0.000 minus 0.001 inch.

The three reamers referred to and the single-point tool-head are all interchangeable with the same size arbor. The construction of this arbor is shown in Fig. 9. The rear end of each tool-head is threaded to fit a collar *A* which always remains on the arbor. The collar is knurled on the outside, and serves to draw the cutter-head back to the shoulder on the arbor. Two keys which project beyond the arbor shoulder engage slots cut across the rear side of the cutter-head and provide a positive drive. The arbor itself has a tongue *B* formed on each side to engage a cross-slot in the machine spindle.

Machining Operations at the End or Head of the Cylinder

The compression ends or heads of cylinders for motors of the type used on automobiles, motor boats, etc., may or may not be machined, the practice varying in different plants and depending somewhat upon the design of the cylinder. Some manufacturers finish the entire surface of the head end to obtain cylinders of uniform depth and a uniform compression in each cylinder when the motor is in operation. Other manufacturers allow these end surfaces to remain rough, and adopt other means of obtaining a uniform depth in each casting. In one large automobile plant, the rough unbored castings are set on the horizontal milling machine (which mills the crankcase ends and other flat exterior surfaces) with reference to the head or compression ends of the cylinders. The castings are so located that the head ends are parallel with the table; hence each cylinder bore is practically the same depth as measured from the finished surface at the crankcase end.

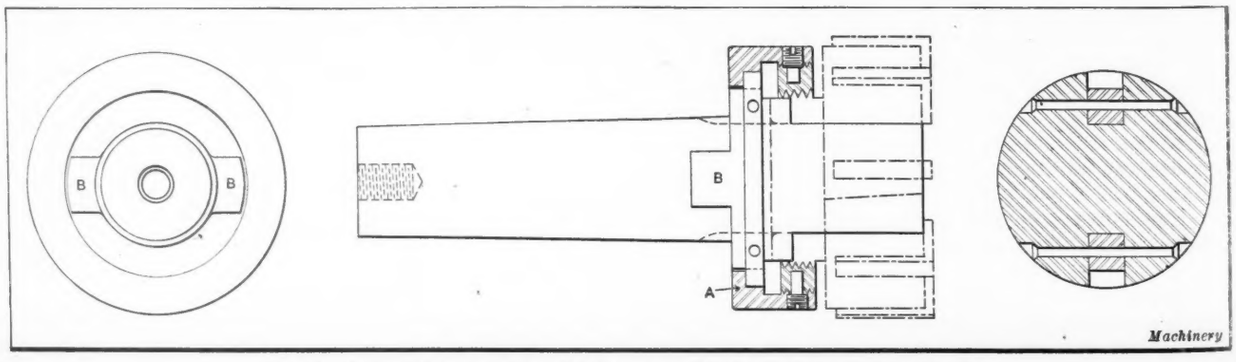


Fig. 9. Arbor used in Connection with Interchangeable Cutter-heads shown in Fig. 8

Some cylinders are slightly counterbored at the inner end, and if this end is closed, it is possible to employ some form of expanding counterboring tool. An under-cutting tool of this type, which is used at the Peerless Motor Car Co.'s plant for counterboring the cylinders, is shown in Fig. 10. The tool *A* is attached to a holder *B* which is pivoted at *C*. An angular slot at the end of the holder engages a pin attached to a central bar *D*. At the upper end of this bar is a cross-pin which passes through an elongated slot in the body of the tool and enters holes in collar *E*. Any upward movement of this collar relative to the body of the tool forces the cutter outward, and vice versa. The collar is formed of two sections which are screwed together, and by adjusting the outer part, the point at which the tool begins to operate can be varied. The tool or cutter *A* is forced out to the working position when surface *F* of the collar comes into contact with the end of the cylinder.

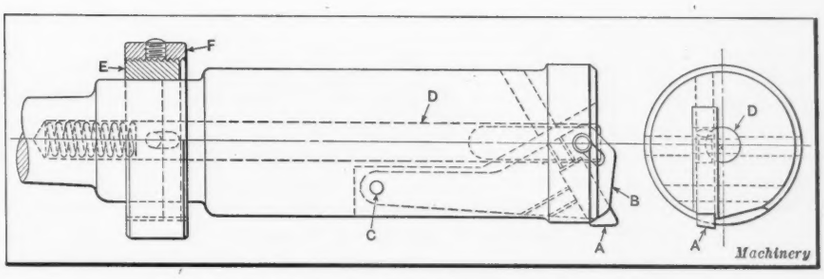


Fig. 10. Under-cutting Tool used for counterboring Cylinders

McCrosky Adjustable Cylinder Reamer

The reamer illustrated in Fig. 12, which is adapted for finishing cylinders, has six high-speed steel blades which are adjustable and are locked in position by drill-rod keys in conjunction with nickel steel clamping screws. Each blade has a drill-rod key embedded partly in it and partly in the reamer body, as shown by the end view, Fig. 13. The head of the clamping screw draws the key tightly against the blade with both a downward and lateral thrust. The blades are tapering along the lower edge, and the slots in the reamer body incline at a corresponding angle; consequently, when the blades are adjusted in a lengthwise direction, by turning the threaded sleeves at the rear, the diameter is varied. These blades are adjusted forward to increase the reamer diameter, so that they always project beyond the end and the reamer never loses its bottoming feature. This reamer is made by the McCrosky Reamer Co., Meadville, Pa. The six-spindle cylinder boring machine shown in Fig. 11 is equipped with another design of adjustable reamer suitable for cylinder work. This type has a threaded collar at the rear end of the blades and another collar recessed into the front end, and the adjustment is made by loosening the rear collar, moving the blades along the inclined slots and then tightening the internal front collar.

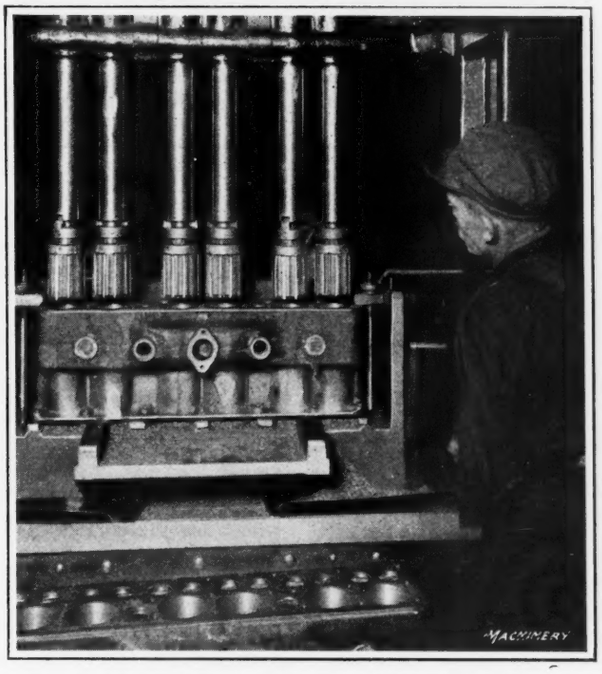


Fig. 11. Cylinder Boring Machine equipped with Adjustable Reamers

National-Cleveland Adjustable Cylinder Reamers

The cylinder reamers illustrated in Figs. 15 and 16 are designed for roughing and finishing cylinders without grinding. The manufacturer—the National Tool Co., Cleveland, Ohio—recommends the use of two roughing reamers and one floating finishing reamer. The second roughing reamer should remove about 0.060 inch stock, and the floating finishing reamer, 0.010 inch. The construction of the roughing reamer, Fig. 15, is practically the same as that of the finishing reamer, except that it is not arranged for a floating action. The floating finishing reamer, as well as the one used for roughing, has eight high-speed steel cutting blades. Each blade is held by a locking screw, and in the center of the reamer there is a double cone adjusting plug which serves to adjust the blades radially. This adjustment is obtained by turning the plug with a spanner wrench, thus forcing the radial pins and the blades outward when this is necessary to compensate for wear. The floating connection between the shank of the finishing reamer, Fig. 16, and the reamer body consists of a ball retainer having four slots spaced 90 degrees apart. Two of these slots engage driving pins in the cutter body, and the other two engage pins in the shank or driving end. This construction allows the cutter-head to float in any direction, so that it will follow the cylinder bore even though the latter is not in perfect alignment with the machine spindle. The ball retainer is enclosed by the shell which screws onto the cutter body.

Martell Floating Parallel Reamer for Cylinders

The Martell floating parallel reamer made by the Taft-Peirce Mfg. Co., Woonsocket, R. I., is adapted for reaming cylinders and similar parts, and is designed to provide a free motion or floating movement at right angles to the axis of the spindle but to prevent any angular deviation from the axis. This reamer has a positive drive which is so arranged that there is a free radial or lateral movement. The construction and the general arrangement of the parts will be apparent by referring to Figs. 14 and 17. The floating movement is derived from a three-part coupling. One section is held by screws to the reamer shank and another part is secured in the same way to the reamer body, and there is an intermediate member, which serves to form two ball races at right angles to each other. These races are on opposite sides of the intermediate part and each contains two balls,

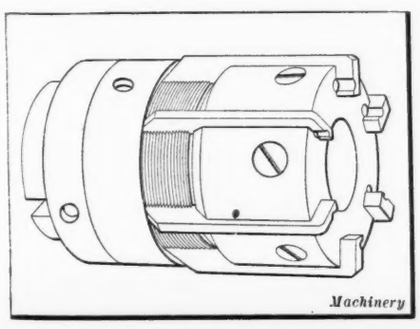


Fig. 12. Adjustable Cylinder Reamer

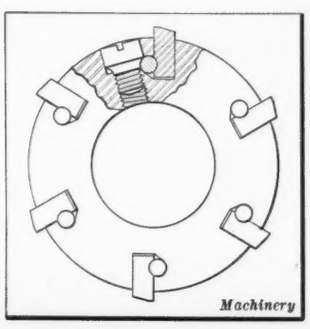


Fig. 13. End View of Reamer

which reduce friction to a minimum. The driving flange of that part of the coupling attached to the shank is provided with two sector-shaped projections,and the driven end of the coupling is of similar form. The sector-shaped projections on the intermediate member mesh with the sectors of the coupling flanges, and the balls are inserted in intervening spaces. A cross-section on line A–A, Fig. 17, is shown in Fig. 18. This sectional view illustrates the sector-shaped projections referred to, and shows the two driving balls on one side of the intermediate member. The two balls on the opposite side are arranged in the same way, except that the ball race is at right angles to the one illustrated. The end thrust necessary to keep the ball surfaces in close contact and prevent any angular floating movement is provided by a ball thrust bearing on the forward end of the reamer, as shown in Fig. 17. This reamer has been called a "floating parallel" type because it is designed to ream a hole that is parallel with the axis of the machine spindle even though the bore prior to reaming may incline somewhat. To test the effectiveness of the parallel floating movement, a cast-iron cylinder was reamed on a drilling machine with a ball bearing floating reamer. After measurements showed that the bore was true, the cylinder casting was tilted slightly by placing a 0.010-inch liner under one side. The cylinder was then reamed again, and notwithstanding the fact that there was a heavy cut on one side and a light cut on the other, the bore was found to be true and in alignment with the machine spindle.

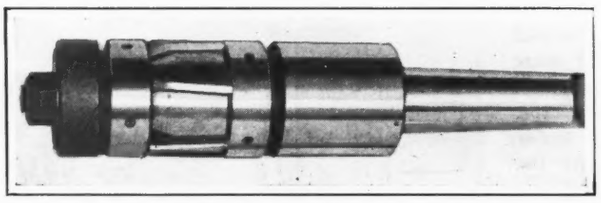


Fig. 14. Reamer designed to float in a Lateral Direction only, or at Right Angles to Axis

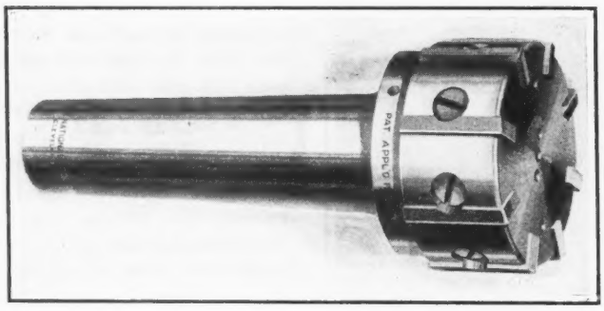


Fig. 15. Cylinder Reamer of Rigid Type

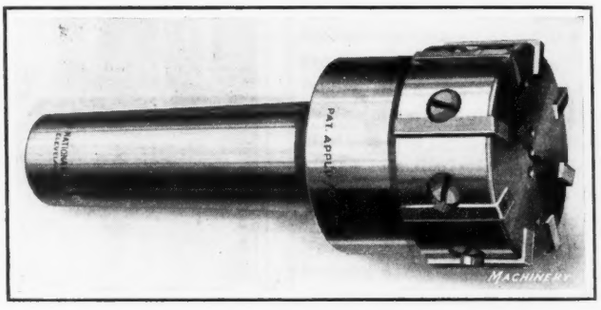


Fig. 16. Cylinder Reamer of Floating Type

Gisholt Shell Reamers of Straight and Spiral Types

The straight-fluted shell reamer, Fig. 19, is adapted for reaming cast-iron cylinders. The right-hand spiral reamer, Fig. 20, is also satisfactory for cast iron but is especially suitable for steel. These reamers are made by the Gisholt Machine Co., Madison, Wis. When using a reamer having spiral or helical blades, the chips work out along the teeth more readily than when the teeth are parallel with the reamer axis. When reaming soft steel which tends to tear, or when it is necessary to remove an excessive amount of stock by reaming, the spiral-fluted type is considered greatly superior to the straight-fluted design. The blades of these reamers are held in grooves formed in the reamer body, thus securing the rigidity of a solid reamer and the advantage of an adjustable type. The blades are adjusted by inserting beneath them thin pieces of paper or tin foil. A hard surfaced insoluble paper, about 0.001 inch thick, is recommended. Tin foil, which can be obtained as thin as 0.0005 inch, is used for finer adjustments. The adjusting strips may be inserted at the ends only, or the screws and blade may be removed and the strip placed under the full length of the blade. The spiral reamer has straight slots for the blades, the same as the straight-fluted type, but the spiral cutting edge is milled on the blade, each blade having one cutting edge. If the reamer does not become dull, this underlaying of the blades may be repeated more than once, but if dulling occurs, regrinding is necessary. The paper or tin-foil underlay is replaced for grinding with a metal strip thick enough to expand the reamer sufficiently to grind it to the desired size. It is recommended that the reamer be ground 0.0005 inch over size and slightly large in front, the taper not exceeding 0.00025 inch to each inch of length. The heel of each blade should be backed off with a cup-shaped wheel, leaving a land from 0.006 to 0.010 inch wide.

Kelly Cylinder Reamers

The cylinder reamer shown in Fig. 21 has two high-speed steel blades or cutters *A* and *B* which are securely held in a steel plate *C* extending through a slot in the body of the tool. A tapered shoulder locking screw *D* passes through the plate which carries the cutters of the reaming tool. The tapered part of this screw engages a hole of corresponding taper in the reamer plate and provides for locking it rigidly in a central position for taking roughing cuts or for regrinding the reamer blades. If this screw is slackened slightly, the reamer is allowed to float sidewise in the slot to compensate for any lack of alignment in the machine. This floating movement should be in the direction of the non-alignment of the machine, and then the reamer will reproduce its size. A floating movement equal to a few thousandths inch, or, in extreme cases, 1/64 inch, is sufficient

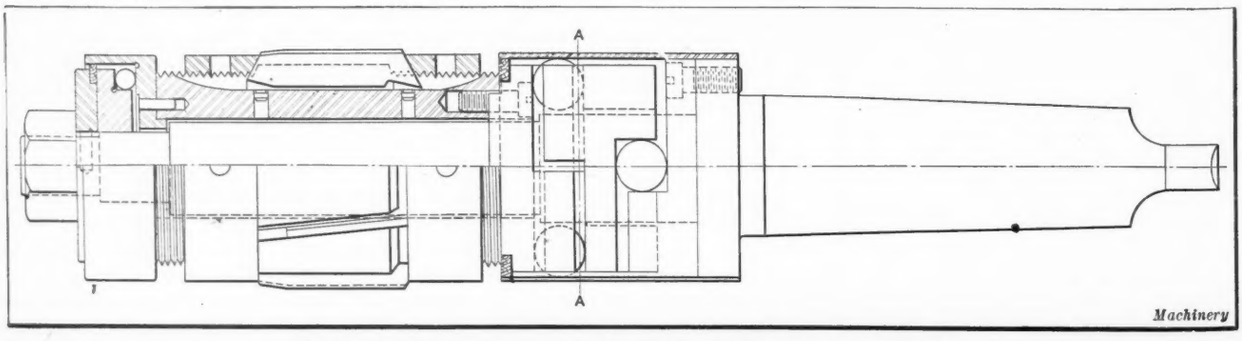


Fig. 17. General Arrangement of the Parallel Floating Reamer shown in Fig. 14

to enable the reamer blades to locate themselves centrally with the bore so that each blade or cutter will do an equal amount of work.

Before using a floating reamer, it is recommended that the hole be bored true to within about 0.005 inch of the required diameter; it should then be reamed before disturbing its central location as bored, so that the reaming operation simply removes the feed marks of the preceding tool. The high-speed steel blades of the reamer shown in Fig 21 are inserted in a 10-degree dovetailed slot, and a 10-degree gib bushing holds them securely in place. At the rear of each blade, there is a hardened screw (see detail view) which gives a direct backing and prevents any change in the adjustment of the blade. If the reamer is under size, it is adjusted by moving one blade outward an amount equal to one-half the error. The opposite blade is then adjusted outward until the dimension across the cutting edges conforms to the required diameter. On the other hand, if the reamer cuts a hole that is over size, the rear adjusting screw of one blade is turned backward far enough to allow this blade to be moved inward an amount equal to one-half of the error; the other blade is then moved inward until the distance across the cutting edges conforms to the required size. The clamp or gib bushing which bears against the side of each blade need not be loosened for making these adjustments, as the blades can be moved readily by rapping them with a soft steel block. The reamer shown in Fig. 21 is one of the designs made by the Kelly Reamer Co., Cleveland, Ohio.

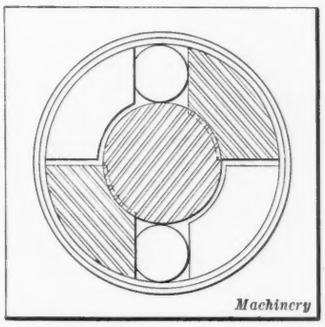


Fig. 18. Cross-section on Line A-A of Reamer shown in Fig. 17

tool is used by the Root & Van Dervoort Engineering Co., East Moline, Ill., for machining the bores of Moline-Knight motors. These cylinders are first rough-bored in a four-spindle Moline cylinder boring machine. The tool used for the first roughing cut has a high-carbon steel blade with two pieces of half-inch square stellite brazed on, thus making a two-pointed cutting tool. The cylinders are rough-bored to within about 0.030 inch of the required size. They are then placed in another machine of the same kind, where the first reaming operation is performed. A floating Kelly reamer is used, the reamer being preceded by a fairly sharp pointed fly cutter. This fly cutter or single-point tool practically cuts a thread in the bore of the cylinder and tends to true up the hole which, owing to the heavy cut taken in rough-boring, is more or less inaccurate. The ridges left by the single-point tool are removed by the reamer, which immediately follows it, and in this operation the hole is enlarged to within from 0.004 to 0.005 inch of the finished size.

The cylinder bores now have a good finish, but they are again reamed on a single-spindle Baker machine. An adjustable multiple-bladed McCrosky reamer is used, and the object of this final reaming is simply to finish the hole accurately to size. As these motors are of the Knight type, two sleeves are required for each cylinder bore, and the holes in these sleeves are machined by practically the same methods as are employed for the cylinders. The method referred to has been adopted after several years of extensive experimenting.

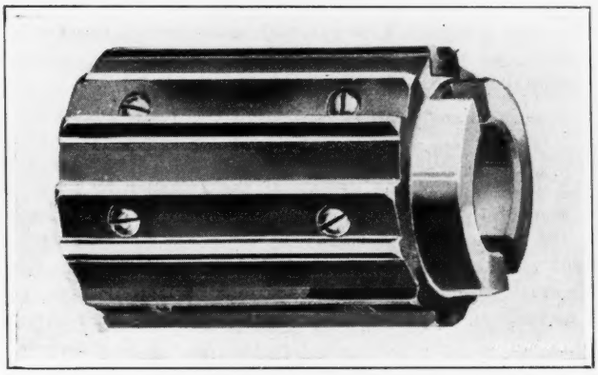


Fig. 19. Straight-fluted Shell Reamer

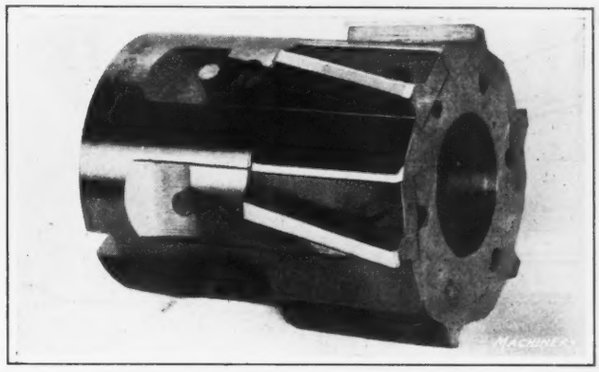


Fig. 20. Right-hand Spiral Reamer

Combination Boring and Reaming Tools

Tools designed for boring and reaming at the same time have been used quite extensively on some classes of cylinder work. One tool of this type, made by the Kelly Reamer Co., is shown in Fig. 22. This tool can be used when the cylinder is revolved and the tool is stationary, or when the work is stationary and the tool revolved, provided the cylinder has an open end so that a hardened pilot may be used to steady the tool. The boring tool is located ahead of a floating reamer, and as this tool is set to within about 0.003 inch of the required radius, it would not be satisfactory if the tool were revolving, provided there were any play in the spindle. This combination tool is considered an efficient type if held in a turret or if it can be provided with a pilot guide.

A combined boring and reaming

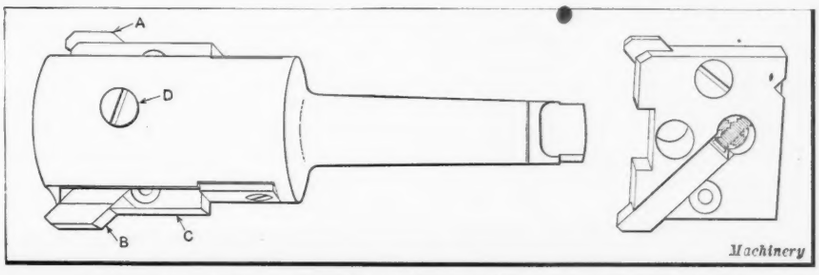


Fig. 21. Cylinder Reamer having Two Blades or Cutters, arranged to operate with or without a Floating Movement

Morse Shell Drill with Guiding Body and Finishing Reamer

The shell drill and expanding reamer shown in Fig. 23 have according to the Morse Twist Drill & Machine Co., New Bedford, Mass., given very good results for roughing and finishing cylinder bores. The particular tools illustrated are intended for cylinders 4⅛ inches in diameter. The shell drill has right-hand helical or spiral flutes, and it is 0.004 inch under the reamer size. Back of the shell drill, there is a cylindrical guiding part which is 0.002 inch smaller in diameter than the drill itself.

Peerless Shell Reamers

Two forms of "Peerless" reamers, made by the Cleveland Twist Drill Co., which are adapted for cylinder work, are shown in Figs. 24 and 25. The eight-blade reamer illus-

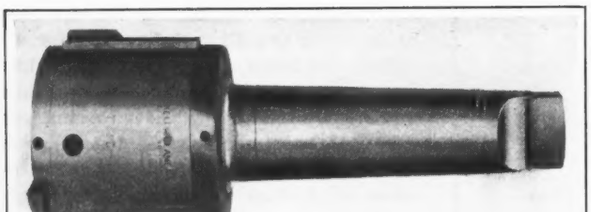


Fig. 22. A Combination Boring and Reaming Tool

trated in Fig. 24 is the type recommended for roughing, and the twelve blade design shown in Fig. 25, for finishing. This particular finishing reamer is of the expansion type. The end is split longitudinally in six places, and it is adjusted by screwing a central bushing in or out. This bushing has a tapering or conical surface, which provides the necessary adjustment, and it is turned by means of a keyed plug. Both the roughing and finishing reamers have high-speed steel blades. The blades are solidly joined to the reamer body, which is made of a special alloy steel, by a process termed "brazo-hardening."

Cutting Edges of Finishing Reamers

Sometimes difficulty is experienced with reamers used for finishing cylinders due to the fact that the blades are not properly sharpened. While the reamer must cut freely,

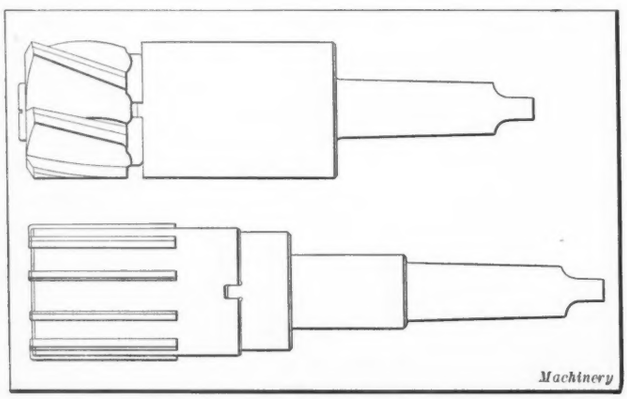


Fig. 23. (Upper View) A Shell Drill having a Cylindrical Guiding Body. (Lower View) A Finishing Reamer

it is essential to reduce the clearance to a minimum, not only to provide a stronger support for the cutting edge, but also to steady the reamer itself and prevent chattering. The National Tool Co., Cleveland, Ohio, recommends the use of the cast-iron lapping ring shown in Fig. 26, in case there is any chattering when using the reamers illustrated in Figs. 15 and 16. This lapping ring is bored 0.003 inch larger than the reamer and it is about 1½ inch wide. This lap is placed over the reamer blades and it is adjusted by means of a screw until there is a slight frictional resistance when it is turned by hand. After placing a little flour emery and oil in the ring, it is revolved a few times while being traversed

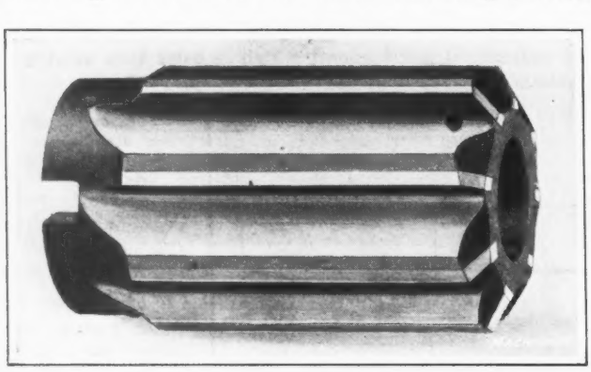


Fig. 24. Shell Core Reamer adapted for Roughing Cuts

along the cutting edges. In this way the sharp razor edge which causes the reamer to cut with a slight chatter is removed.

The reamer may require sharpening after a ten-hour run, although the length of time naturally varies considerably according to the nature of the material being reamed. When sharpening is necessary, the reamer blades are first adjusted by loosening the screws which hold them and turning the adjusting plug. The screws of two opposite blades are then tightened and these blades are measured for size. If the diameter is correct, the other blades are fastened in place.

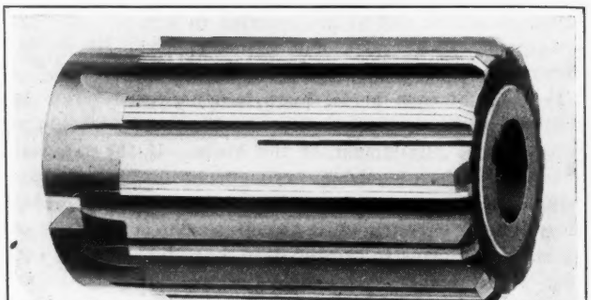


Fig. 25. Expansion Shell Reamer for Finishing Cuts

A three-cornered carborundum stone, ½ inch wide and of medium grade, is recommended for sharpening the blades. If the blades have been given too much clearance, the reamer will have a tendency to cut with a tremor or even with a chatter, and if this occurs, the ring lap previously referred to should be used.

Pilots for Cylinder Reamers

The use of pilots on cylinder boring and reaming tools may depend upon the design of the cylinder or upon the opinion of the tool designer, foreman, or superintendent as to the advantages of steadying tools by means of pilots. Many cylinders are so designed that the use of a pilot below the cutting tool would be impossible, simply because there is no opening in line with the center of the cylinder through

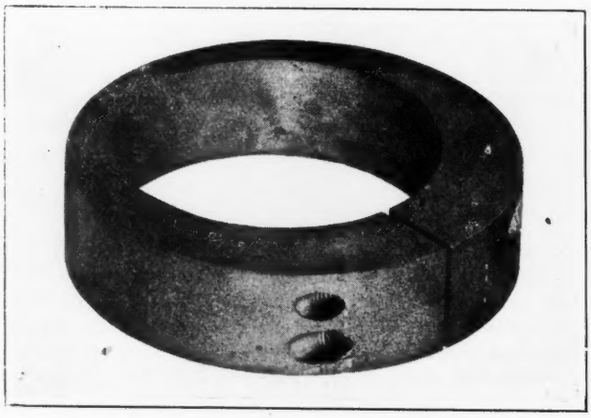


Fig. 26. Cast-iron Lapping Ring for reducing Clearance on Reamer Cutting Edges

which a pilot could pass. Even when there is an opportunity of using pilots, in most plants making automobile motors the boring and reaming tools of vertical-spindle machines are guided by bushings above the cutter-heads, these bushings being supported by the bridge or top of the fixture. When pilots enter bushings below the cutting tools, there is often difficulty due to the entrance of chips and dust in the bushing hole. One method of overcoming this difficulty, at least partially, is to use either a leather or felt washer to exclude the chips and dust from the bearing surface. This washer is attached to the fixture at the top of the bushing and fits the pilot closely. Another method is to steady the pilot by means of rollers instead of using a plain bearing

or bushing. The rollers themselves should be concealed and protected as far as possible. The Continental Motors Co. has designed a fixture equipped with pilot rollers and intended for machines used for rough-boring cylinders.

What is known as the "strip pilot" provides means of adjusting the pilot itself to take up any play between the pilot and guide bushing. These strip pilots have been used by the Nordyke & Marmon Co. and they are also applied to some Kelly reamers. The pilot, instead of being in the form of a plain cylindrical extension, is provided with four hardened strips which are held by screws into grooves extending lengthwise along the pilot. With this construction, any wear of the pilot or play between the pilot and bushing may be eliminated by placing liners back of the hardened strips and then regrinding them to the required size. Some Kelly reamers, designed especially for reaming cylinders having ports in the sides (such as the cylinders of two-cycle engines), have what are known as "hardened strip rear pilots." The strips, in this case, are above the cutting tools and they fit closely into the finished bore of the cylinder, thus steadying the tool. This rear pilot also serves as a gage, in that it will bind in a cylinder bore which is not reamed up to the standard diameter. It is recommended that the cylinder be bored to within 0.015 to 0.020 inch of the final size before using the rear pilot type of reamer.

* * *

QUALIFICATIONS OF A DRAFTSMAN

Any man who aspires to become a draftsman or designer—and a great many young shop men have this aspiration—should understand that the work of a machine or tool designer does not consist merely in the drawing of lines on paper. While every man engaged in mechanical work, whether he intends to become a draftsman or not, should learn the rudiments of mechanical drawing so that he can read drawings and sketches without difficulty, this knowledge is by no means sufficient for a successful draftsman. Drawings are merely a universal mechanical language, and the mechanic who does not understand the first principles of making drawings encounters many difficulties. A sketch tells much that cannot be described in words. It is almost as impossible for a man engaged in mechanical pursuits to succeed if he does not understand mechanical drawing as it would be if he could not read or write. Every mechanic, therefore, should understand how to make a simple drawing, but a designer, in addition, must be fairly well versed in mathematics and elementary theoretical mechanics, the principles of machine design, and the strength of materials, all of which constitute the foundation upon which a broad engineering education may be built. Without this foundation, the machine designer will constantly meet with difficulties and find serious limitations in his efforts to succeed. A good designer must also be well versed in shop practice, so that he knows how the machine parts which he designs are to be executed in iron and steel. In fact, he should have a general knowledge of patternmaking, foundry work, machine shop practice and toolmaking, in addition to his specialized knowledge of drawing and machine design.

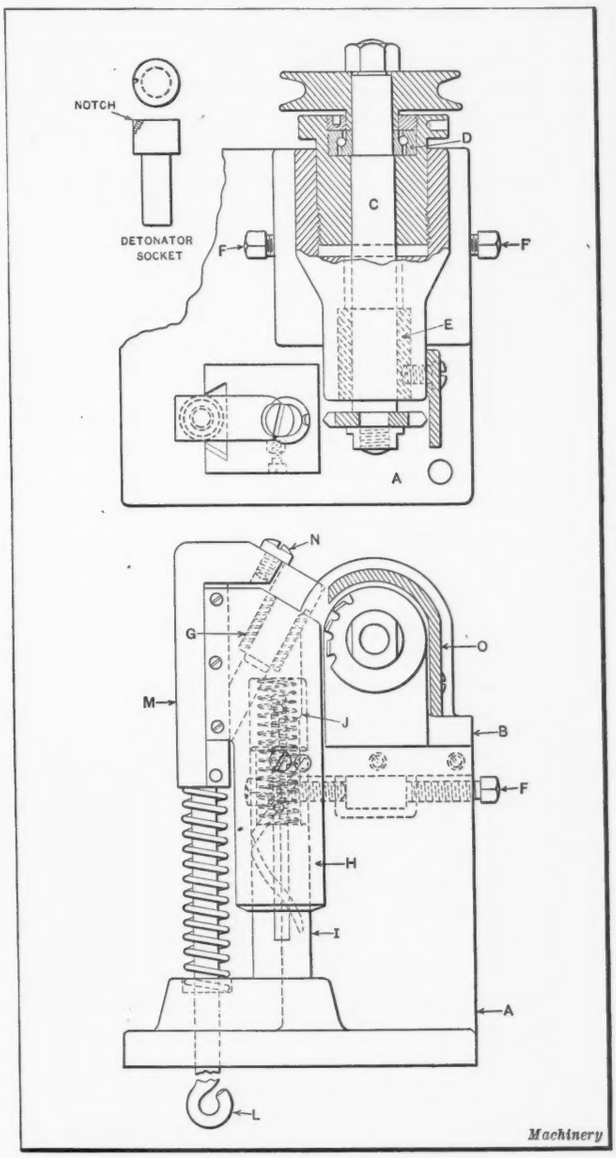
* * *

DETONATOR SOCKET MILLING FIXTURE

BY DONALD A. BAKER

A fixture for milling the V-shaped notch in a detonator socket is shown in the accompanying illustration. As will be seen, it consists of a cast-iron base *A*, which can be fastened to a bench. On this base is mounted a sliding head *B*, which carries a ball-bearing cutter-spindle *C*. This spindle is provided with a combined radial and thrust ball-bearing *D* at the rear end, but runs in a plain bronze or cast-iron bearing *E* at the front end. The ball bearing, which must be very carefully adjusted in order to prevent crushing or excessive loading of the balls, is mounted in an adjustable bushing so that the spindle may be adjusted endwise at any time by screwing the bushing either in or out as desired. Adjustment of the cutter for depth may be made by two screws *F*, which abut against a lug on the under side of the spindle-carrying head *B*, this head being dovetailed and gibbed to slide in the base.

The work is placed in a bushing *G* carried by a spring-operated slide *H* that is a free sliding fit on the hardened and ground post *I*. This post has a keyway ground lengthwise of it into which a hardened and ground key fits; the key is doweled to the sliding member *H* to hold it in alignment. When the work is being placed in position, slide *H* is held up by means of a coil spring *J*. A downward movement of a foot-treadle connected to rod *L* causes the



Detonator Socket Milling Fixture

secondary slide *M* to move down; then the head of the screw *N* comes into contact with the work and holds it securely in place as the continued downward movement brings into play the pressure of the spring *J*. As both slides and work continue downward, the work is passed by the cutters and the notch is cut. As both the operator's hands are entirely free to handle the work and as a guard *O* protects the operator's fingers from coming into contact with the cutter, the operation is very rapid, and from 6000 to 7000 pieces per day can be notched. The spindle speed of this machine is about 2000 revolutions per minute, while the rate of feed is dependent on the ability of the operator. The work is passed by the cutter just as rapidly as it is possible to operate the treadle which controls the work and the clamping slide of the machine.

ETCHING AND ETCHING FLUIDS

BY A. SCHLEIMER

There are innumerable formulas for etching fluids, but for some unaccountable reason many of them are of a more or less complex nature. However, the fact is that anything that will combine with or chemically attack any substance can be used for etching that substance. For instance, moisture will attack iron, producing what is commonly known as rust, and iron or steel could be readily etched by exposing it to moisture, first protecting the parts that are not to be etched. The objection to this particular method, however, is that it would require an exceedingly long time to etch the iron or steel to an appreciable depth. Etching may be described simply as the removing of part of a substance so that a mark or design becomes visible by relief. It can be done mechanically, but the principal reason for not employing this means is that it can be done easier chemically.

Coating Surface to be Etched

One of the most important things, and one which is most frequently overlooked in using the chemical process, is the proper application of the ground which is used to protect the parts from the action of the corroding fluid. Some form of wax on which etching fluid has no action is generally used for this purpose. If the wax is too soft, the point of the engraving instrument will cut through, leaving only a very fine line so that the fluid has little opportunity of reaching the metal, as a layer of air will prevent actual contact. On the other hand, if the wax is too hard or brittle it will be broken and split along the edges of the engraved line in the same manner that glass will break when struck, and while these minute fractures cannot be seen, the result will be a blurred design.

The nearest approach to a perfect ground for general purposes is beeswax of the proper consistency, which can be easily applied in any desired thickness. Before applying the wax, it is important that the surface be thoroughly clean and absolutely dry, and the difference in temperature between the wax and the article to be etched should be slight. If it is necessary to dip the piece into melted wax, the article should be kept immersed for a few moments until it acquires the same temperature as the molten wax. The necessity of having the surface perfectly clean and dry is easily explained, for if there is a film of oil on the surface, the wax will cover but not adhere, and in consequence the etching fluid will run under the wax and produce a smear or blur. The same effect is produced by moisture, except that in this case the blur is likely to be worse, as there is an affinity between water and etching fluid causing spreading.

Formulas for Etching Fluids

The following fluids have been tried on various substances and found to work satisfactorily:

Iron and Steel—Hydrochloric acid (full strength) should be used. Nitric acid, however, must not be used.

Brass—Nitric acid.

Copper—A mixture containing 2 parts of nitric acid and 1 part sulphuric acid.

Silver—Nitric acid, 3 parts, water, 1 part.

Gold—A mixture containing 1 part of nitric acid and 3 parts of hydrochloric acid. This mixture should be prepared just before being applied and should be used warm, under a hood or fume closet.

Platinum—The same mixture as that used for gold.

Lead—Nitric acid.

Aluminum—A 10 per cent solution of caustic soda or potash.

Zinc—A mixture containing equal parts of hydrochloric acid and water, used warm.

Glass—Hydrofluoric acid. The article may be immersed in the liquid acid for a few minutes or it may be exposed to the fumes from five to fifteen minutes. Extreme caution should be used in handling this acid, using rubber gloves for the hands and a lead or hard rubber container for the acid. Contact with the skin will cause severe burns, and the action seems to be continuous, producing burns far more severe than those caused by the mineral acids.

All of these acids may be used full strength and will act instantly, but if the etching is to be of considerable depth most of them may be diluted with water before applying. This will require more time, but will produce a cleaner cut. The exception to this is the mixture for gold and platinum, which must always be used full strength and applied as warm as the melting point of the wax will permit.

Electro-etching

Another method of etching is that which is performed by the use of electricity. When the wires leading from the poles of an electric battery are placed in a solution of copper sulphate, and a copper plate is attached to the positive wire, the object to be plated being attached to the negative, an electroplating outfit is formed. The deposition of a metal will not take place on any substance but a metallic one, and it is this fact which makes it possible to employ electricity in etching. When the battery is in action, the copper is taken from the anode, or article attached to the positive wire, and deposited on the cathode or article attached to the negative wire. First let it be assumed that a piece of sheet copper is used as a cathode. In the ordinary course of procedure, the copper from the anode, when properly regulated, will be removed and deposited in a fairly even surface on the cathode. Now suppose that a design is painted on the anode like the letter A with wax, varnish, or any substance that will not be affected by the solution. When the current is flowing, the copper will be removed only from the exposed surface of the anode; the protected surface will not be affected. In consequence, it will be found that after a time the design will stand out in relief. This illustrates the principle, but the method may be varied; for instance, the background may be coated instead of the design, in which case the figure will be etched and the ground will stand out. Also, the operation may be performed on the cathode instead of on the anode, in which case the exposed parts are built up.

The variations possible in using this process may be shown by the following example. Expose the letter A on an anode of copper or gold. The result will be that the letter will appear in relief. It should then be carefully rinsed in clean water without disturbing the ground. Suppose, for instance, that gold is used and it is exposed on the cathode in a silver bath, the silver being deposited in place of the gold that has been removed. Removing the piece from the bath and cleaning, the letter A is found designed in silver on a background of gold. This method is, of course, applicable to any combination of metals.

A Process of Electro-engraving

A process of electro-engraving was patented some years ago that is exceedingly interesting and ingenious, although not successful from a commercial standpoint. A block of some porous substance was first made on the top or upper surface of which was formed the reversed design that was to be etched. The bottom of this block was then set in an electrolytic solution and the plate to be etched was laid on the upper surface of the block as the anode. Contact was made by the solution reaching the plate at the points where it touched the porous substance only, the solution reaching these points by capillary attraction. Naturally the metal plate gave up metal at these points only, and as the solution continued to eat its way into the plate, a design was gradually etched or engraved.

Another method that is very convenient is to make an imprint or design on a piece of metal by means of printers' ink, and then apply powdered asphaltum to the design before it has time to dry. After it has dried, the surplus powder is dusted off and the plate heated. The asphaltum will melt and solidify when cooled. The acid may then be applied and the etching process carried out. When the work is completed turpentine should be used to remove the asphalt.

DEVELOPING DESIGNS FOR MACHINERY AND TOOLS

BY F. E. JOHNSON

A designer's efficiency may be measured to a certain extent, by his propensity for adopting ideas which experience has proved to be of practical value. Satisfactory results from a new machine, if attained without much experimental work after its completion, are nearly always due to accurate knowledge that the designer possessed or obtained during the designing period, and not by haphazard guesswork. Chance plays but a minor part. When the experienced designer's judgment or that of his advisers fails to establish complete confidence in an idea

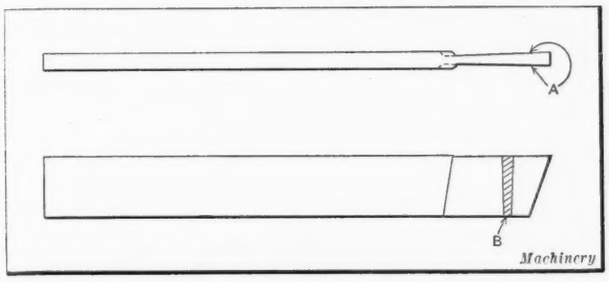


Fig. 1. Parting Tool to be ground

or principle upon which the success of a project is based, he avails himself of the experience of others by studying successful machines, contrivances and literature which will aid him in solving his problem. Experience is always a safe guide as a means of avoiding unexpected expense in obtaining the results desired in a new machine. When the element of doubt as to the successful application of a principle cannot be dispersed, it is always safer to conduct some experiments before incorporating any factor of uncertainty into a design. If the principles of construction are correct, errors in design of details can be remedied. Failures often result when fundamentals are not well considered.

Cost of Designing a New Machine

The cost of a new machine, including its design, making the patterns, and the machining operations, which are generally accomplished without the aid of special tools and fixtures, will be excessive if, in addition, many changes in construction are later found to be necessary in order to obtain the results required. The fundamental principle upon which a satisfactory design is hinged should be proved correct beyond doubt, in order to avoid confusion, expense and delay being caused by the discovery of serious defects when the machine is tried out. In many such cases, a designer who has a fondness for detail will have added to the general expense by having given time and attention to many refinements in the general design, which might have been dispensed with in the first machine.

It is seldom the case that every condition and requirement has been so thoroughly analyzed by a designer that it will be impossible for the shop to suggest improvements after a trial of the machine. Perfection of design and operation is a matter of evolution.

Evolution of Design of a Specific Machine

Let it be assumed, for example, that a designer is required to produce a small special hand-operated machine for use in grinding the side clearances of a parting tool. The first question that arises, if the quantity required warrants the expense of building such a machine, is: On what general principles shall it be designed?

The parting tool to be ground is similar to that indicated in Fig. 1 and it is to be ground on the sides *A*, as shown. Assume, further, that no specific instructions have been received as to the method of procedure, nor any information furnished, outlining what the general construction must be, but that these fundamentals must depend upon the designer's initiative. The tool must be ground in the best and most rapid manner possible and the machine must be built as economically as the fulfillment of every requirement will allow. Probably the first idea that suggests itself is the use of two grinding wheels; one on each side of the parting tool, operating simultaneously, as shown by the sketch, Fig. 2. The tool would be clamped in a suitable holder fixed permanently to the body of the machine, and the wheel-slides would be traversed back and forth in unison taking one or more cuts as required.

The traverse of the slides would be obtained through the rack attached to them engaging with suitable pinions. On the opposite end of each of the pinion shafts there would be a similar pinion. These lower pinions would receive motion from a long rack, oscillated by means of a pinion fixed to the shaft which connects with the handwheel gearing. Reduction in gearing would very likely be required to overcome friction and the weight of the slides, and to give sufficient rotation and ease of movement to the handwheel when operating. As it would be necessary to provide adjustment for the grinding wheels, the main slides would necessarily be compound and the wheel cross-slides provided with a handwheel and screw. The center line of the grinding wheels would be somewhat below that of the work, in order to obtain the clearances required in the parting tool. For instance, the use of a wheel of 8 inches diameter would require a difference of about 3/16 inch from the center line of the tool to that of the grinding wheels. The angle of the wheel-spindle center line in relation to a center line through the work is shown exaggerated in the sketch Fig. 2,

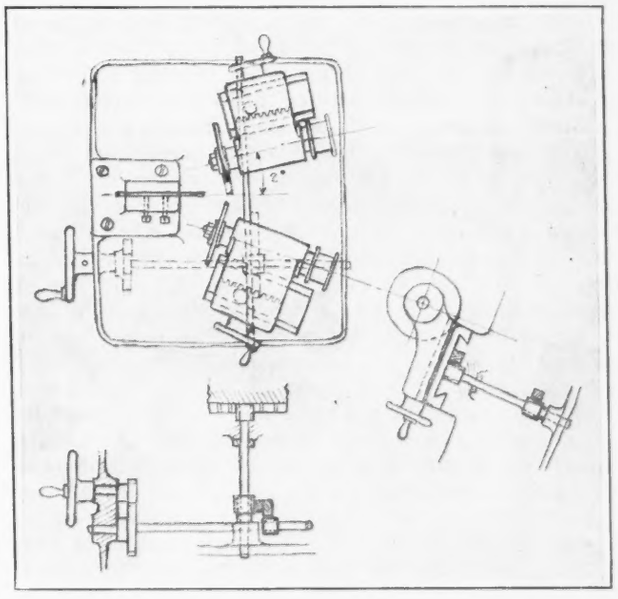


Fig. 2. Free-hand Sketch of Two-wheel Construction with Traversing Wheel-slides

in order to convey the idea. The 2-degree angle should be ample to obtain the clearance required for the parting tool blade back of the cutting edge.

The means of transmitting motion to the wheel-slides, as shown in the sketch, could be improved without question, as there is too much gearing, but a definite method has been proposed, and as principles only are at present being dealt with and not details, time spent in this direction would not be profitable. The designer at this point would discuss the principal features outlined in this sketch with his superiors, before attempting any development work. The two adjustments required for the wheel-slide, one from each side, is a point that can be criticized, and as the machine must be hand-operated, a reduction should be made in the quantity and weight of the parts which must be put into motion, in

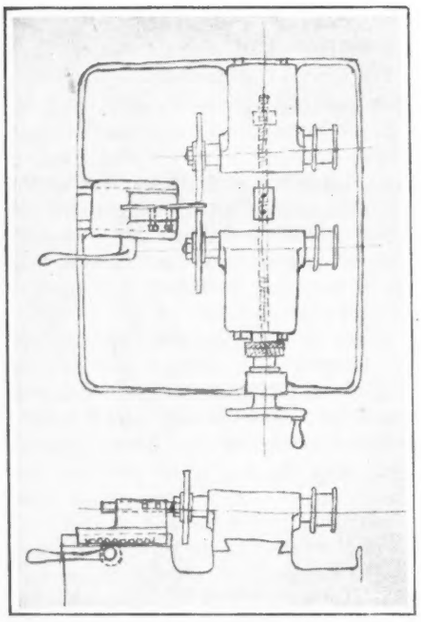


Fig. 3. Two-wheel Design with Sliding Work-holder and Screw-operated Wheel-slides

order to obtain greater simplicity of construction. Any means used to give motion to the pair of wheel-slides, if designed so as to be sufficiently sensitive to operate easily, would involve complications which it is possible to avoid.

Another scheme, as shown in Fig. 3, might result from these conclusions. The idea of operation is the reverse of that shown in Fig. 2. The work-holder, instead of being a stationary fixture, is mounted on a slide and operated by a hand-lever through a rack and pinion. In this design the wheel-slides would remain stationary, except when feeding in to make a cut, or, when backing away. The slides would be connected with a left- and right-hand screw and operated by a handwheel. As no two grinding wheels will wear in exactly the same proportion, it would be necessary to have some compensating device so that when necessary, one slide could be adjusted independently of the other. This could be accomplished by designing a feed-screw nut, so that it might be moved back or forth on the screw, carrying a slide and provided with means for locking in the desired position.

This construction would evidently reduce the cost of building the machine. The feature of grinding the clearance angle, which the first design provided for, however, is missing. If the work-slide is the member in motion and the wheel-slides are fixed, it will be impossible to grind the 2-degree angle clearance back of the cutting edge of the tool. As this clearance is slight, it might easily be obtained by hand grinding in a moment's time, and that particular feature could be dispensed with because of the advantages of the simplified construction.

The work thus far—until a design has been decided upon for development—is only in the form of sketches. Now the question arises: Is the idea as a whole good in principle; would it be thoroughly practical and should the designer develop a machine along the lines suggested? In the case at hand there may not have been any previous precedent or experience on which to base judgment, but a close study of details would create a doubt as to the practical value of such an arrangement. The thickness of the stock for the tool is only ⅛ inch and when ground, the heel *B* of the tool, Fig. 1, would be less than 1/16 inch thick. The tool would project from its holder 1¼ inch without having an end support. As the machine should be of light construction, considerable vibration would be caused by driving the two wheels at the required speed. The side clearances obtained for the parting tool by the use of this form of grinding wheel would constantly change with wear. This point may not be considered a serious defect, but as a matter of principle it is not correct. The work, when brought into contact with the grinding wheels, would deflect, and intense vibration or chatter would be caused by starting the cut from the end of the work. This is a natural consequence, since the tool stock has not the rigidity to withstand a harsh cutting action. This point can be more clearly comprehended if it is imagined that only one wheel is brought into contact with the work instead of two. The use of two wheels would not overcome this condition to a sufficient extent to permit rapid and satisfactory grinding results to be realized. In similar doubtful cases, an experiment with a makeshift arrangement would be of benefit to obtain actual knowledge of what the working conditions might be, so that some experience is gained for a safe and reliable basis upon which to build.

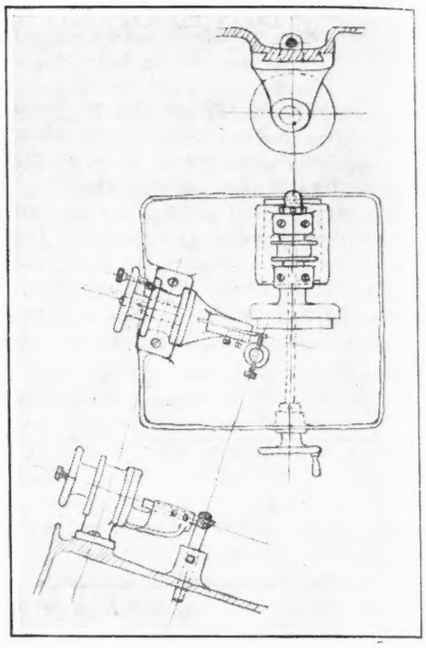


Fig. 4. Single-wheel Construction with Indexing Fixture and Support for Work

Overcoming Defects in Original Design

The conclusion reached in this particular case is that the designer must adopt another viewpoint, and consider a design that will require only one wheel for the purpose, and that will provide the projecting portion of the tool with some form of backing or support to resist the grinding wheel pressure exerted in making a full-face cut.

Fig. 4 illustrates how this might be accomplished. In order to grind both faces of the tool, it will be necessary to index the work to present the opposite side after the grinding operation on one face has been completed. A cup-wheel or ring-wheel has been substituted in this design, so that a uniform side clearance is obtained regardless of wear. The work and wheel-spindle are on the same center line, as indicated in Fig. 5. The indexing fixture is set at an angle necessary to obtain the 2-degree clearance required back of the cutting edge of the tool. The operating handwheel carries a spring plunger, which locks the fixture in the desired position. A thumb-screw is carried in a post, which may be adjusted vertically and, when grinding, is brought to bear against the work, and may be released sufficiently to allow for indexing. The wheel-slide is operated by means of a screw and handwheel. Although but one wheel is used, the operation of grinding the parting tool blade should be very rapid. It requires only a moment's time to release the resistance screw and to index the fixture. The design should provide for wet grinding, a water tank, pump, wheel cover, and water piping being necessary.

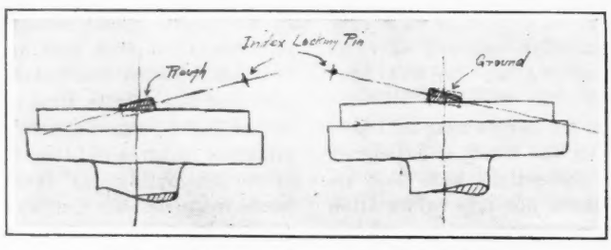


Fig. 5. Relative Positions of Work and Wheel

As a single-wheel machine has been found to be the preferable means in this case, it may be decided not to design a complete machine, but to buy one of the numerous types of small grinders that are on the market and to simply design an indexing fixture that may be adapted to the grinder.

Making the American Hand Grenade

Second of Two Articles on Methods of Machining and Loading the Bodies and Assembling the Bouchons

BY EDWARD K. HAMMOND

IN the first installment of this article which appeared in the January number, the general design of the American hand grenade was referred to, and the practice of the Gorham Mfg. Co. in machining and loading grenade bodies was described. In the present installment, which concludes the article, a detailed description will be given of the methods used in assembling the bouchon, setting the fuse in place in the detonator, mounting the detonator, and packing the completely assembled bouchon for shipment.

Assembling Operations on the Bouchon

The first step in assembling the bouchon consists of putting together the bouchon body, the striker, the hinge pin upon which the striker is mounted, and the spring which actuates the striker. For this purpose, use is made of fixtures of the type shown in Fig. 16. First the spring is put into place in the fixture which is provided with two lugs so that opposite ends of the spring may be caught over these lugs in order to put it under the necessary tension. Then the striker is put into place, and finally the bouchon body, after which handle *A* is pushed over toward the right, the purpose being to slide a mandrel, operated by this handle, through the holes in the bouchon and striker, which are provided to receive the hinge pin. A supply of hinge pins is contained in a magazine *B*, and the next step is to move both handles *A* and *C* to the left. This results in pushing a hinge pin from magazine *B* into contact with the end of the mandrel operated by handle *A*, and then advancing the hinge pin into position in the wake of the mandrel, which clears the path for it, by bringing the various members into accurate alignment. During the time that the assembling operation is being performed, the operator keeps her foot on the treadle connected to rod *D* which forces a jaw *E* down on the work, thus holding it in the desired position in the fixture.

After assembling the parts mentioned in the preceding paragraph, the next step is to ascertain that the striker functions properly. A special fixture is provided for this purpose which has a crank carrying lugs that engage the striker so that, as the crank is turned, the striker swings backward and forward about the hinge pin. If this test is made with satisfactory results, the crank is finally revolved far enough to enable the cotter-pin or safety pin to be entered into the hole so that the striker is held back. The fixture used for this purpose is shown in operation in Fig. 17, and a better idea of its design will be gathered from Fig. 18, which shows a closer view of the machine; the bouchon has been removed in this view to show the construction more clearly.

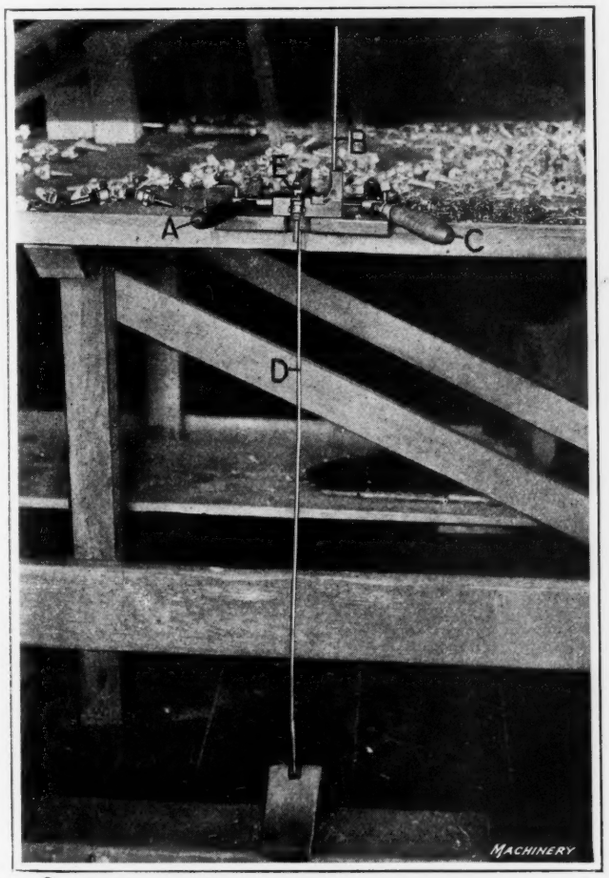


Fig. 16. Fixture used for assembling Bouchon Hinge Pin, Striker, and Spring

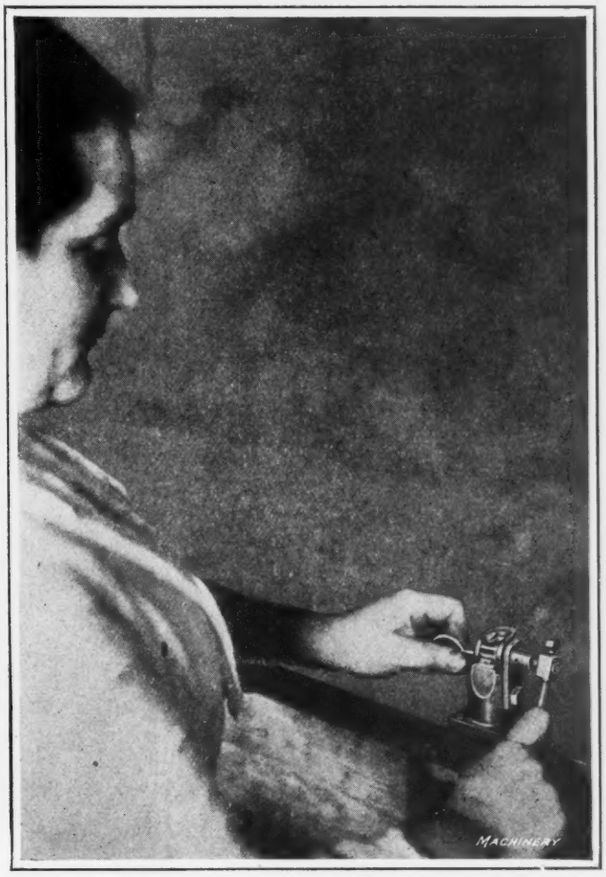


Fig. 17. Fixture used for holding back Striker while inserting the Safety Pin

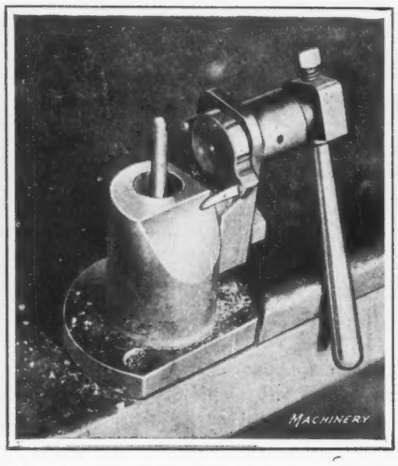


Fig. 18. Close View of Fixture shown in Fig. 17 with Bouchon removed

Fig. 19. Gaging Thickness and Spacing of Bouchon Walls

Fig. 20. Gaging the Spreading of the Ends of the Safety Pin

Gaging the Bouchon Wall Thickness

Next in the process of assembling comes the step of gaging the thickness and spacing of the walls of the bouchon to see that these are accurate and properly spaced. For this purpose, the girls engaged on this work use snap gages, one of which is shown in use in Fig. 19. It consists merely of a gage with two spaces provided to receive the opposite walls of the bouchon, in order that both the thickness of the walls and their spacing may be tested.

Inserting the Primer in Place

Those bouchons which pass inspection now go to the girls whose duty it is to insert the primers. For this purpose, No. 1 Greenerd arbor presses like the one shown in Fig. 21 are used which are provided with special fixtures for handling this work. Carried on the base of the arbor press there is a small fixture on which the primer is placed in an inverted position; the bouchon is then placed over the primer with the top of its stem engaged by the ram of the arbor press. When the work has been located in this way, the ram of the press is forced down, causing the bouchon to be pushed over the primer. The downward movement is continued until the body of the bouchon comes into contact with a flange on the fixture that supports the primer, which shows that the primer has been seated to the required depth.

Gaging and Inspection

At this point, the work is given a complete visual inspection and, in addition, 20 per cent of the partially assembled bouchons are gaged by the inspectors to determine definitely that all of the work of assembling up to this point has been properly done.

Placing a Moisture-proof Seal over the Primer

In order to have a hand grenade function properly, it is obviously necessary for the primer to be adequately protected from moisture. To provide for protecting the primer, the first step is to apply a coat of shellac on the flange inside the bouchon, which is located around the primer, this shellac being tinted with rose aniline in order to make it easy for those engaged on this work to see that a uniform coating has been applied. After applying the shellac, the next step is to press a tin-foil or lead-foil disk (shown at *P*, Fig. 1, in the January Number) into position above the primer. This operation is performed by a No. 1 Greenerd arbor press equipped as shown in Fig. 22, the plunger being of such a diameter that it goes down over the top of the disk and presses it firmly into contact with the shellacked surface of the bouchon. When this has been done, a second coat of rose-colored shellac is applied around the edges of the disk, which makes a thoroughly moisture-proof seal. Par-

Fig. 21. No. 1 Greenerd Arbor Press for inserting Primers

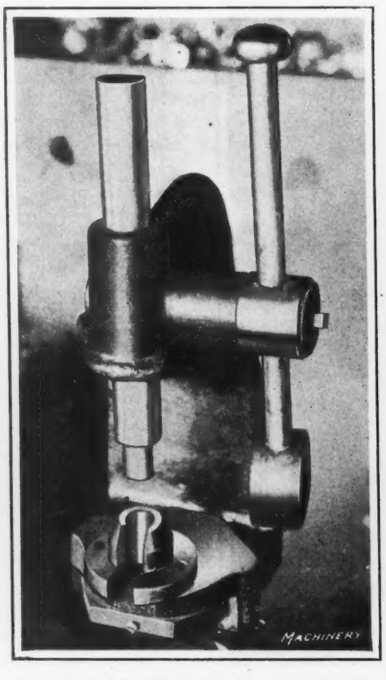


Fig. 22. Arbor Press for inserting Tin-foil Shields

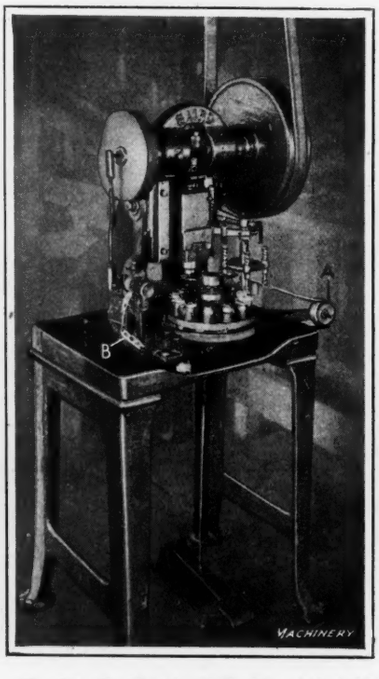


Fig. 23. Machine for shellacking and seating Primers

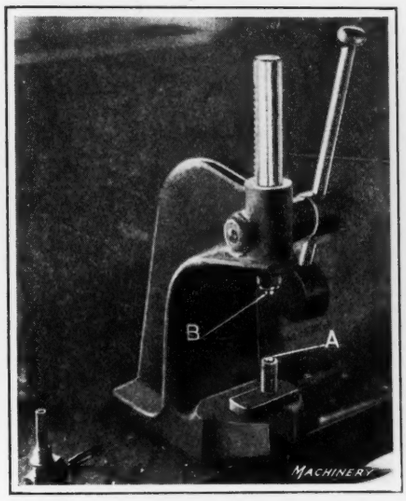


Fig. 24. Arbor Press for spreading Opening in Bouchon Stem

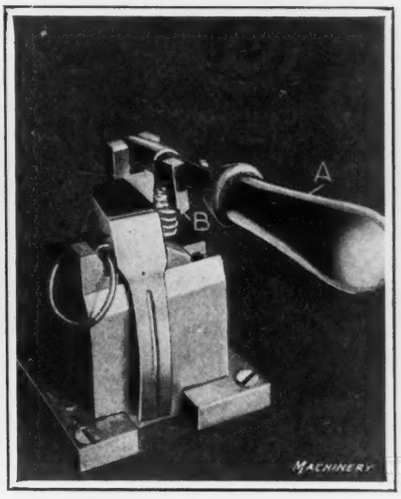


Fig. 25. Fixture for spreading Ends of the Cotter Safety Pin

Fig. 26. Fixture for holding Striker while putting on Cover

ticular attention is called to the fact that the tin-foil or lead-foil disk used for this purpose is not over 0.005 inch thick, so that it does not offer any obstruction to the effectiveness of the striker in igniting the primer. When aluminum foil is used, it is only 0.0025 inch thick.

The Gorham Mfg. Co. has recently installed a special machine, built by the Baird Machine Co., of Bridgeport, Conn., which provides for automatically applying the first coat of shellac, stamping out the tin-foil disk and pressing it down into place in the bouchon, and applying the second coat of shellac over the top of the disk. This machine is shown in operation in Fig. 23, where the coil of tin foil from which the blanks are stamped is shown at *A*, and the opposite end of the tin-foil ribbon from which the disks have been blanked out is shown at *B*. The use of this machine saves the performance of three operations by hand, and enables the work to be done with far greater rapidity than was formerly the case.

Spreading the Stem of the Bouchon

Reference to Fig. 1 will make it apparent that the detonator shell *H*, which forms a housing for the lower end of the fuse and for the detonating charge of fulminate indicated at *G*, projects up into the stem that extends out from the lower end of the bouchon. The bouchons are die-castings composed of 90 per cent of lead and 10 per cent of antimony, and, as received at the plant, the inside diameter is too small to enable the detonator shell *H* to be easily slipped into place. To facilitate the work of the operators engaged in the performance of this task, the next step in assembling the bouchons is to spread the lower end of the stem in order to form a bell-mouth into which the shell *H* may easily be slipped. This operation is performed on a No. 1 Greenerd arbor press equipped as shown in Fig. 24. Here it will be seen that mounted on the platen there is a fixture which carries a small pilot *A* which projects about ⅛ inch above the flange of the body in which it is carried. Pilot *A* is slightly beveled at the top and is of such a size that the hole inside the stem of the bouchon will rest on the beveled surface but will not drop over the pilot. With the bouchon in this position, the ram *B* is brought down into the opening at the top of the bouchon and the entire bouchon is pushed down into contact with the flange surrounding the pilot *A*. This opens up the stem of the bouchon sufficiently to receive the detonator shell, the work of spreading the opening being facilitated by having the stem of the bouchon split for a distance of ⅜ inch.

Placing the Cover on the Bouchon

It will be recalled that the fixture shown in Fig. 18 is used to pull back the striker to provide for inserting the safety pin which holds the striker back against the tension

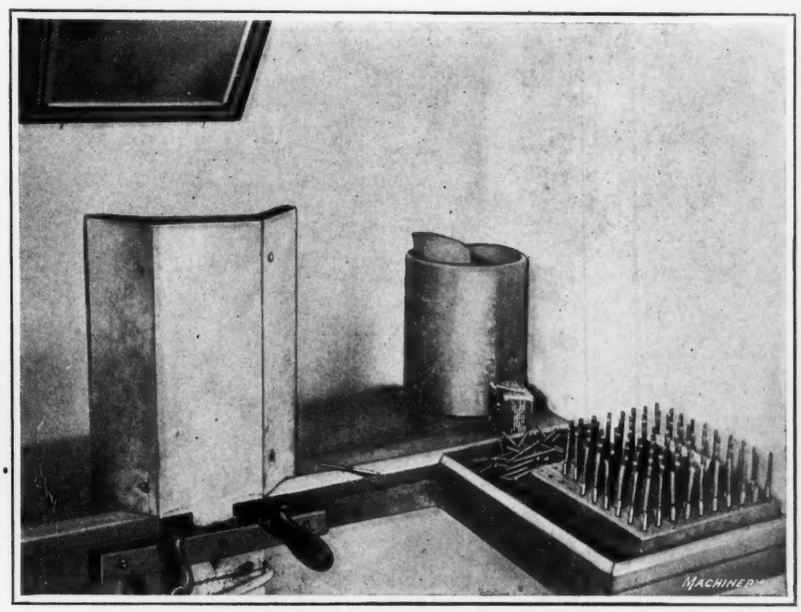


Fig. 27. Equipment in Booth where Fuses and Detonators are assembled and crimped before being loaded into Bouchon

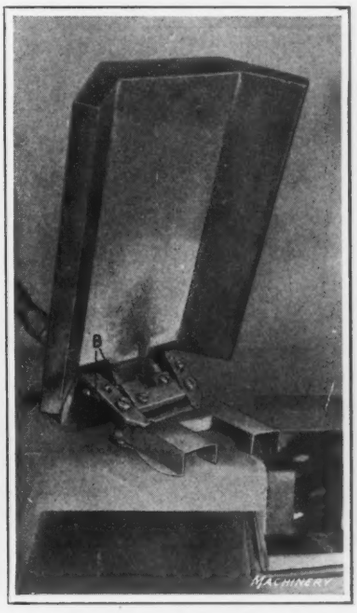


Fig. 28. Mechanism of Fixture shown in Fig. 27

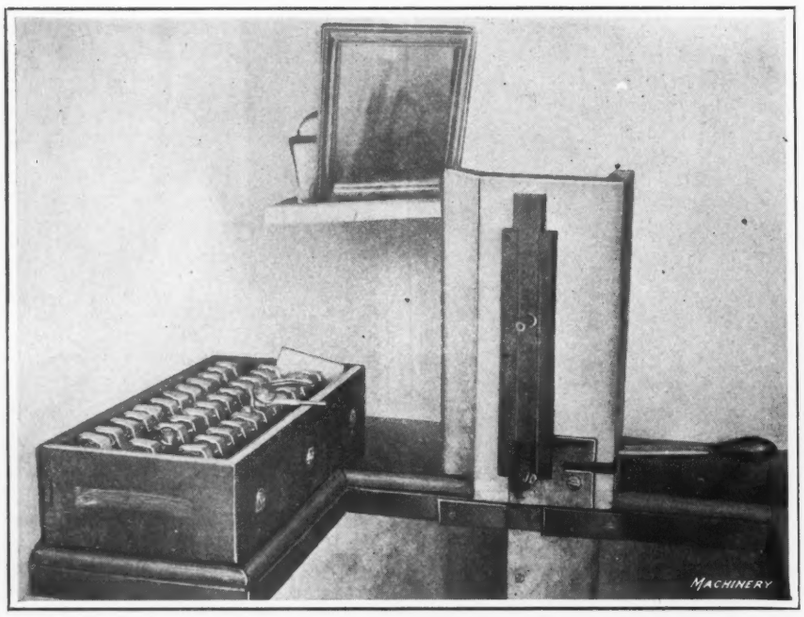


Fig. 29. View of Equipment in Booth where the Fuse and Detonator Assemblies are placed in Bouchons

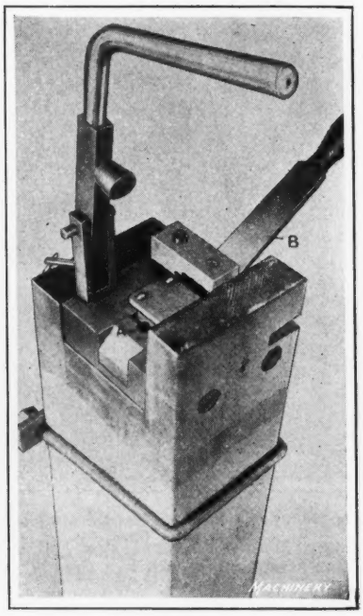


Fig. 30. Mechanism of Fixture shown in Fig. 29

of the striker spring. The next step in assembling the bouchons is to put on the cover, and, in order to do this, it is necessary to withdraw the safety pin. For this purpose, use is made of a fixture in which the bouchon is inserted as shown in Fig. 26. This fixture is provided with a finger attached to the lever that provides for engaging the striker and holding it down so that the safety pin may be withdrawn without allowing the striker to be thrown over onto the primer. After this has been done, the cover is put in place on the bouchon, and the safety pin slipped back through the holes in both the cover and bouchon, so that the striker is held down under the cover. Just before this operation, the bouchon assemblies are given a 100 per cent gaging between the bouchon wings to make sure that they have not been distorted in handling.

The bouchons are then passed along to the operator whose duty it is to spread the ends of the cotter-pin so that this pin will not be withdrawn unless considerable force is applied by pulling on the ring attached to the pin, a pull of from 10 to 25 pounds being specified. The fixture shown in Fig. 25 is used to accomplish the spreading of the cotter-pin in the following manner. Referring to *K*, Fig. 2, it will be seen that one side of the split cotter-pin is longer than the other and that the end of the longer side projects past the end of the shorter side. The operator, in placing the bouchon in the fixture shown in Fig. 25, makes sure that the longer side of the cotter-pin is at the bottom. When the bouchon is in place, the operator pulls down on the lever *A* which brings block *B* into contact with the projecting end of the cotter-pin, thus bending it the required amount. The bouchons are then subjected to a general inspection, and particular attention is paid to gaging the spreading ends of the cotter-pin with a chisel-pointed gage which is shown in use in Fig. 20. After this part of the work has been completed, the bouchons are sent on to the government inspection department, where they are given a complete inspection before going to the loading department.

Assembling the Fuses into the Detonators

In connection with the description relating to the operation of hand grenades, an explanation was given of the form of fuse that is employed. These fuses are sent to the plant in cartons containing one thousand fuses each. They are made by the Ensign Bickford Co., of Simsbury, Conn.

Fig. 31. Dipping Detonators and Bouchon Stems in Shellac to form Waterproof Seal

Fig. 32. Dipping Tops of Bouchons in "Vatudrip" to prevent Rust from accumulating

It is possible that, by referring separately to the copper shell *H* and the charge of fulminate *G* contained in the bottom of this tube, as shown in Fig. 1, the reader may have failed to have gained a true conception of the exact nature of these detonators. At this point, particular attention is called to the fact that the copper shells, loaded with fulminate at their lower ends to a depth of ⅝ inch, are made by the E. I. Dupont-de Nemours Co., and are sent to the plant ready for use. The copper shell with its charge of fulminate is known as a "detonator." It is powerful enough to blow the hand to pieces, and must be handled with care, as fulminate is very sensitive to shock.

The first step in loading the bouchons consists of assembling the fuses into the detonator, and, for this purpose, use is made of the apparatus shown in Figs. 27 and 28. Each outfit of this kind is contained in a separate booth in order to avoid danger of an explosion of detonators in charge of one operator spreading to the material which is being used by others employed in the same department. Care is also taken to safeguard the operator in each individual booth just as far as it is possible. An explanation of how this is done will probably be better understood after explaining the nature of the assembling operation. It is necessary to slip the fuse down into the detonator tube until the lower end of the fuse comes into contact with the fulminate, after which the top of the copper tube is engaged between a pair of jaws on the crimping fixture and squeezed up so that the copper fits tightly around the fuse. The way in which this result is accomplished will be best understood by referring to Fig. 28, where it will be seen that there is an opening *A* into which the detonator and fuse are slipped with the fulminate at the lower end. This hole is of such a size that it just accommodates the detonator, but as the plate containing the hole is cut away to remove a portion of the opening, it will be evident that the detonator extends out a short distance beyond the front edge of the plate. Sliding in contact with this edge there are two jaws, one of which is partially shown at *B*, and these jaws are caused to slide inward by pushing the two hand-levers shown in Fig. 27 toward each other. As the inner ends of jaws *B* come into contact, they clip the wall of the detonator at a point close to its upper end and squeeze it up to a sharp edge, thus causing the wall of the detonator to be drawn closely into contact with the fuse.

We are now prepared to call attention to the special means provided for the safety of girls employed in the performance of this work. Mention has already been made of the fact that the detonator is put into the fixture with the fulminate end downward, and it will be seen that at the front of the fixture there is a guard which extends up to a point level with the top of the operator's head. In order to put the detonator into the fixture, the operator is compelled to reach beyond this guard, and in order to see her work and the fixture, the girl looks into a mirror attached to the wall of the booth in front of her. After the detonator has been put in place, the girl must remove both of her hands and grasp the two levers in order to close the jaws to perform the crimping operation. This cannot be done without grasping the two levers simultaneously. As a result, the girl's hands are bound to be out of the danger zone, and the guard plate prevents the possibility of an explosion injuring her eyes. It will be seen that under the fixture there is a square shaft or box extending down below the work-bench. The lower end of the detonator containing the charge of fulminate is over this opening, so that space is provided to take up the expansion which would be caused if a detonator exploded, thus avoiding danger of wrecking the fixture and injuring the operator. As a matter of fact, the instances in which a detonator has exploded are extremely rare, and in each case nothing in the nature of injury to the operator has resulted.

Fig. 33. Rack on which Bouchons are drained after dipping in Rustproof Solution and Case being packed with 384 Bouchons Ready for Shipment

Assembling the Fuse and Detonator into the Bouchon

In connection with the work of sealing the fuse into the detonator body, a description was given of the way in which a portion of the copper wall of the body is drawn up to a knife-edge, in order to cause the remainder of the detonator wall to fit closely around the fuse. The next step is to push the end of the fuse and detonator up into the lower end of the stem that projects down from the bottom of the bouchon. This will be best understood by referring to Fig. 1. A description has already been given of the way in which the bouchon stem is spread in order to facilitate assembling the fuse and detonator into place, and it will also be seen that the lower end of this stem is split to receive the crimp or knife-edge portion of the detonator. After the fuse and detonator have been pushed up into the bouchon, it is necessary to crimp the stem of the bouchon at its extreme lower end and also at a point ⅝ inch up from the lower end to prevent the flash of the primer from traveling outside of the fuse to the explosive. This is done in the fixture shown in Figs. 29 and 30. The best idea of the way in which this fixture operates will be gathered from Fig. 30, where it will be seen that there is an opening *A* between two jaws that are actuated by a lever *B*. After the detonator and fuse have been inserted in the stem of the bouchon, lever *B* is pushed over and by means of a cam action, this lever closes the jaws onto the stem of the bouchon, thus causing it to be squeezed into a tight fit around the detonator. Two crimp-

ing operations are performed on this machine—one at a point at the extreme end of the bouchon stem, and one at a distance 5/8 inch up from the bottom, the object being to make the joint between the bouchon and detonator as nearly moisture-proof as possible.

Inspection, Shellacking, and Rustproofing

After the assembling of the bouchons has been completed on the machines shown in Figs. 29 and 30, each bouchon is given a complete visual inspection, and those which are found to be perfect in every respect are sent on to a department in which the first step is to dip the detonator and stem of the bouchon into rose-colored shellac to a point about ½ inch above the lower end of the bouchon stem. The purpose of this treatment is to seal the joint and make it as completely moisture-proof as possible. The dipping operation is accomplished by first placing the bouchons in racks holding twelve bouchons, as shown in Fig. 31, and then dipping their ends in the shellac and afterward placing the rack over the draining tank where it remains for a sufficient length of time to allow the excess shellac to drip off. Handling the work in this way, very little time is required to dip the bouchon stems into the shellac. When the shellac is dry, the next step is to dip the cover end of the bouchon into "Vatudrip" rustproof solution, which is found desirable because the covers of the bouchons are made of sheet steel and the same material is used for making the striker spring and hinge pin. If the bouchon were subjected to considerable dampness the rust might prevent the striker mechanism from functioning freely. Fig. 32 shows the method of applying the rustproof solution. After it is dry, the bouchons are packed in cases containing 384 bouchons each and sealed up ready for shipment. A case practically filled with bouchon assemblies is shown in Fig. 33. The method of sealing the boxes is the same as that described in connection with the packing of loaded grenade bodies.

Organization and Capacity of the Hand Grenade Plant

In laying out the hand grenade plant of the Gorham Mfg. Co., and purchasing its equipment, the work was based upon providing sufficient capacity for turning out 100,000 finished grenades a day. The buildings were erected at the beginning of last year and manufacturing operations had gotten under way by the latter part of March. For machining the grenade bodies, an equipment of forty-eight drilling and forty-eight tapping machines is provided, having a capacity for turning out 50,000 grenades in a nine-hour shift. Consequently, two shifts are necessary to obtain the daily production that is required. For assembling the bouchons, the section of the plant devoted to this work is divided up into units in each of which eighteen girls are employed; and the complete work of assembling is handled on a long table in each unit, on which the complete equipment of the unit is set up to provide for performing the various assembling operations progressively. There is a total of thirty-six of these units, and two nine-hour shifts are required to give the necessary production. In loading the bouchons, there are forty booths equipped for sealing the fuses into the detonator bodies, and forty booths for sealing the bouchon stem around the detonator. Each booth has a capacity for loading 2500 bouchons a day, which gives the required rate of production.

* * *

The consolidation of the Niagara Falls Power Co., the Cliff Electrical Distributing Co. and the Hydraulic Power Co. of Niagara Falls, N. Y., into a new corporation under the name of the Niagara Falls Power Co. has created the largest electric power company in the world as regards energy output. Approximately 2,000,000,000 kilowatt-hours will be generated yearly in the hydro-electric plants of the company. The company, including the plant of its subsidiary, the Canadian Niagara Power Co., has an installed capacity of 370,000 horsepower and is installing an additional 100,000 horsepower which will be ready for operation during the year 1919.

CONFLICT OF COMPENSATION ACTS

BY CHESLA C. SHERLOCK

Large employers of labor who do business in several states are frequently perplexed as to the apparent conflict of the law relating to the recovery of compensation for injuries received while at work. It has been pointed out before in these columns that there is a great difference in the amount to be recovered for certain specific injuries in the various states, 16 2/3 per cent per week more money being recovered by the injured workman in Massachusetts than in Iowa or Rhode Island. There are corresponding differences between the amount of recovery and the basis of recovery in other states.

Compensation Recovered in State in which Accident Occurs

This situation naturally leads one to question where the workman is entitled to recover for his injury—in the state where the accident occurred, in the state where the contract of employment was entered into, or wherever he may find the employer? It might seem at first thought to make slight difference as to where the injured workman brings his action, so long as he recovers the compensation due him. The employer having paid the compensation according to the terms of the law in one state cannot thereafter be called upon to pay it according to the terms of the law in another state. However, there is a very material difference as to where the action is brought, and one which causes a great deal of dispute oftentimes. Workmen want to recover where the law is the most favorable to them, if there is a possibility of their bringing an action in more than one state, while employers prefer to pay their obligation in the state which is most favorable to them. Neither one of the parties can be criticized for this natural desire. Hence the need of understanding the rules of law applicable in such cases so that it will not be necessary to rush to the courts for needless litigation.

It is a general rule of law in regard to the conflict of compensation statutes that the law of the state in which the injury occurred controls the right of the injured person to recover for such injuries. This does not mean, however, that the courts of another state may not try the case if they have jurisdiction of the parties. Such courts may try the case, but in their proceedings they will not be governed by their own law, but by the law of the place where the event giving rise to the cause of action occurred. This is a well-known principle of conflict of laws.

For instance, in one case a workman was employed in a tunnel under the St. Clair River. He was sent from the American side of the tunnel to the Canadian side and was injured there. It was held that the recovery must be under the laws of Canada, as his injury occurred there. In another case, a workman was injured in Ohio and brought suit in Indiana. It was held that while the case could be tried in Indiana, it must be governed by the laws of Ohio. In another case a workman was injured by a load of timber which had been negligently loaded in New Mexico, but the accident took place in Texas. It was held that the laws of Texas would govern.

Compensation Acts have no Extra-territorial Effect

While the general rule is as above stated, there are many jurisdictions holding that the law of the place where the contract of employment was entered into shall govern in all subsequent actions for injuries received while in such employment. In a New York case, where a contract was made in Germany for service on a vessel which was to commence at Hamburg and end there after the vessel had been to New York and back, it was held that the law of the place where the contract was made would control. This naturally raises the question of whether the compensation statutes have extra-territorial effect. The New York court has said that the German compensation act has extra-territorial effect by the decision mentioned above. If the com-

pensation acts have extra-territorial effect, then it is logical to argue that if a contract of employment is entered into in a state not having compensation acts and the injury occurs in a state having such legislation, the rule mentioned in the New York case would have to be rocognized and no recovery could be made, even though the state statute where the injury occurred expressly declared compensation to be payable for injuries occurring within the state.

It is certainly within the bounds of reason to say that the power of a state legislature, in the matter of statutory enactments, extends to the territorial limits of the state for which it acts. If the legislature of a foreign country can enact a law that will govern in New York, there is something wrong with either the sovereignty or the judicial branch of the state of New York. If the state of Massachusetts can enact a compensation statute which will follow Massachusetts workmen around the world, then the power of the Massachusetts legislature extends not only to the territorial limits of that state but to the territorial limits of the world.

While several of the states have said that the compensation acts have extra-territorial effect, happily this is not the general rule and is not supported by the weight of authority. It is not followed in the majority of the courts here and it is not recognized in the courts of Great Britain. In an English case, a workman was hired under the laws of the United Kingdom and sent to perform the duties of his employment outside the limits of the British Empire. The courts of England held that he was not entitled to relief under the English law because the accident had not occurred within the territory of the British Empire.

Sober thought would certainly indicate that there is nothing wrong with this reasoning. What some of the courts have stoutly denied in the case of other legislation, they have just as emphatically declared to be true under the compensation acts. If the legislature of one state can enact general laws applicable only within the territory of that state and of no effect elsewhere, then the same rule should apply in the case of compensation laws. It can be stated on the weight of great authority that the compensation acts have no extra-territorial effect.

Mode of Procedure in Recovering Compensation Governed by State in which Action is Brought

Another question that often causes considerable dispute is as to the mode of procedure. If the law of the place where the accident occurred is to be followed, must the usual methods of procedure in the state where the action is instituted be foregone and the unknown practice and procedure in the state where the accident occurred be used? This is not the case. It is a recognized principle of conflict of laws that in matters of form and procedure the law of the place where the action is commenced shall govern, or the *lex fori*.

The Supreme Court of California said: "Ordinarily, statutes of the several states regulating remedies by means of judicial proceedings are to be understood as intended to apply only to proceedings in the courts of the particular state, unless it clearly appears that they were intended to have a wider scope."

The Alabama court said: "The rule is general, of great practical importance, and has been frequently acted upon, that 'when by a statute a new right is given, and a specific remedy provided, or a new power and also the means of executing it are provided by statute, the power can be executed and the right vindicated in no other way than that prescribed by the statute.'"

Taking a specific example, this means that if the state of New York enacts a statute creating a new right which has never existed before in law, and prescribes a definite manner in which that right is to be exercised, the right can exist only where it is possible to follow the procedure in the manner indicated. Let us take the compensation acts as a concrete example. In New York, as elsewhere, when the compensation acts were enacted, it was necessary to outline a mode of procedure to enforce them. The courts, being antagonistic in principle, could not be expected to enforce the acts according to their true spirit. It was necessary, then, to form an Industrial Commission before which compensation cases were to be tried and procedure followed as outlined in the statute. This procedure was absolutely different from any procedure followed by any court in any state in the union. The right to compensation could not be established unless this procedure was followed.

We have said, with the sanction of sufficient authority, that the law of the place of the accident shall govern in case a workman brings a suit for compensation. We have also said that the *lex fori* governs in matters of procedure. Suppose that a workman is injured in New York, which has a compensation statute, and he desires to bring an action for it in South Carolina, which does not have a compensation act nor an Industrial Commission. According to the *lex fori*, it would appear that the New York law would be applied by the procedure in South Carolina. But would it?

It seems that the words of the Alabama court carry with them the weight of authority, and the workman could not bring his action in South Carolina or any other state which did not have a compensation act or a commission to carry it out according to the procedure usually followed in such cases, for "the power can be executed and the right vindicated in no other way than that prescribed by the statute." And it is further a principle in the conflict of laws that is recognized as being authoritative, that the law of other states will not be enforced in a given state, if to enforce it will contravene the established policy of the latter state.

However, where the proper machinery exists for the enforcement of a right in a given state, such state will enforce the rights conferred by the statutes of another state where it is possible to enforce the right in the manner prescribed by statute. This means that a workman injured in New York can go into New Jersey or any other state having a compensation act and the machinery to enforce it and make recovery according to the terms of the New York act.

The conflict of laws is a matter which is extremely interesting and one that is hard to determine. Employers doing business in several states should acquaint themselves with the general complexion of the conflict of compensation acts, for it will tend to bring about more speedy adjustment of these cases. In the preceding, we have found that the following general principles apply:

1. The law of the place of the injury governs as to the amount of compensation that may be recovered.

2. The compensation acts have no extra-territorial effect, as a general rule.

3. The *lex fori* governs as to procedure and manner of recovery.

4. Compensation cannot be recovered in a state which does not have the necessary machinery to enforce the right.

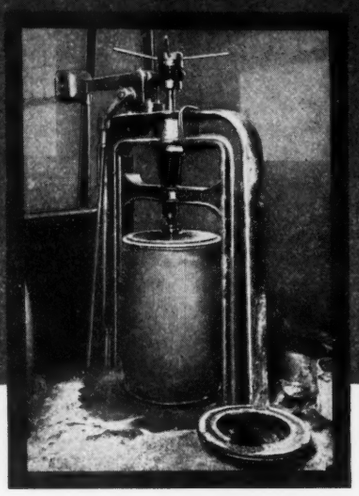
* * *

FRANCE NEEDS RAW MATERIALS

In a statement by Jules B. Clausse, prominently connected with large industrial enterprises in France, emphasis was laid upon the need for machinery in the restoration of France. His view is that, as the machinery required must be obtained at the cheapest possible price and in the shortest possible time, it must be manufactured in France, but the raw materials for this industry must be imported. At the end of the war, 1,700,000 men and women were working in French shops on war materials. In order to keep these men and women employed, raw materials will be required in great quantities. He further advocated that all taxes which raise the price of raw materials artificially, such as tariff duties, should be abolished. For the present, goods so completely lacking as are many of the metals, should be permitted to enter France free, and complete commercial liberty should be given to the industries.

Manufacture of Steel Barrels

By Edward K. Hammond



Blanking the Barrel Heads, Bending the Sheets for the Bodies, Welding, Flanging, Brazing, Bilging, Pickling and Testing

IN the cooperage department of the Standard Oil Co. at Bayonne, N. J., there is a branch that is engaged in the manufacture of bilged steel barrels. At the time when a decision was reached to start making barrels of this type, there were two reasons why it was desirable to change from the familiar form of wooden barrel with steel hoops, namely, the relatively short life of wooden barrels and the steadily increasing cost of wood suitable for use in cooperage shops. Several years of experience with the use of steel barrels has demonstrated the fact that they are unusually well suited for many classes of service, but the prediction made some time ago that barrels of this type would completely replace wooden barrels has not as yet been justified. In fact, during the past two years the cooperage department of the Standard Oil Co. has made more wooden barrels than at any time in its history, although this must not be construed to mean that the production of steel barrels has fallen off in any way.

Raw Material of the Steel Barrel Industry

Hot-rolled steel is used for making steel barrels, and according to the process used by the Standard Oil Co., three pieces of steel are required to make a complete barrel. One piece of 13-gage steel forms the body, and two pieces of 12-gage steel form the heads at each end. This raw material comes to the plant in sheets of such a size that those used for making the barrel bodies only require a slight amount of trimming under a squaring shear; the sheets from which the heads are made are of sufficient size to provide for blanking and drawing three heads from each sheet.

There probably is no one point in the successful manufacture of steel barrels which is of more importance than the chemical composition of the steel from which they are made. When the Standard Oil Co. started in this work, a great deal of trouble was experienced in welding the side seams in the bodies. What appeared to be perfectly satisfactory welds were produced, but during what is known as the "bilging" operation—of which a complete description is presented in a later section of this article—the barrel would either break at the weld or at a point close to one side of the weld. This appeared to be due to crystallization of the steel. Material was purchased from various steel makers who had been told in detail of the requirements of the work in hand, but for a long time none of this material gave satisfactory results.

Many steel salesmen were eager to obtain this business and spoke with great confidence of the ability of their metallurgists to produce steel which would fulfill all requirements. Sample shipments were sent in and barrels produced from the steel, and in some cases the results obtained were apparently all that could be desired. The trouble lay in the fact that the results were not uniform; sometimes a considerable run of barrels would be obtained that fulfilled all requirements, but suddenly—and for no apparent reason—the barrels would begin to fail at the welded section. Metallurgists in the employ of the United States Steel Corporation spent eight years working on this problem and eventually produced a steel which gives very satisfactory results, the loss of barrels through failure at the weld now amounting to not over 1 per cent. This development work was started about thirteen years ago, and is of interest at this time in showing the amount of perseverance and patience which was required in perfecting the steel barrel industry.

Making the Barrel Heads

A 500-ton press built by the Toledo Machine & Tool Co., Toledo, Ohio, which is shown in Fig. 2, is used for making the barrel heads, and as has already been mentioned, three heads are obtained from each sheet of steel. Two men are employed to operate the punch press, one standing at each side of the platen so that the sheets are passed through from front to back. The making of the barrel heads is done in combination drawing and blanking dies, which cut out a blank of the required diameter and draw it up to the form shown at *A* in Fig. 1. In addition to blanking and drawing the heads, the Interstate Commerce Commission requires that each head shall be marked with the date on which the barrel was made;

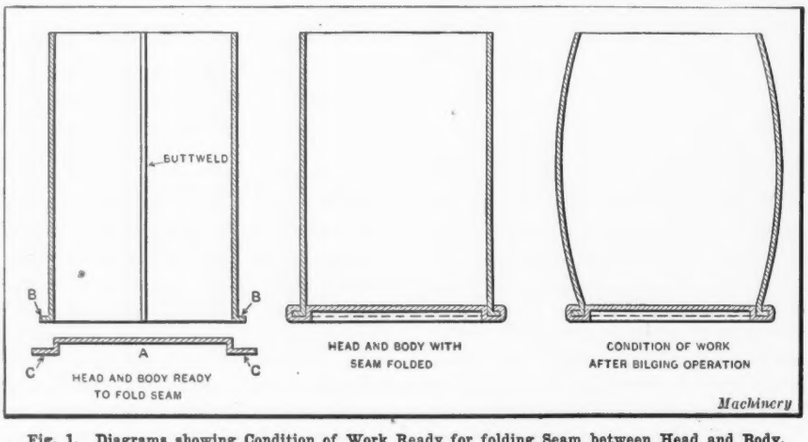


Fig. 1. Diagrams showing Condition of Work Ready for folding Seam between Head and Body, after the Seam is folded, and after the Bilging Operation has been performed

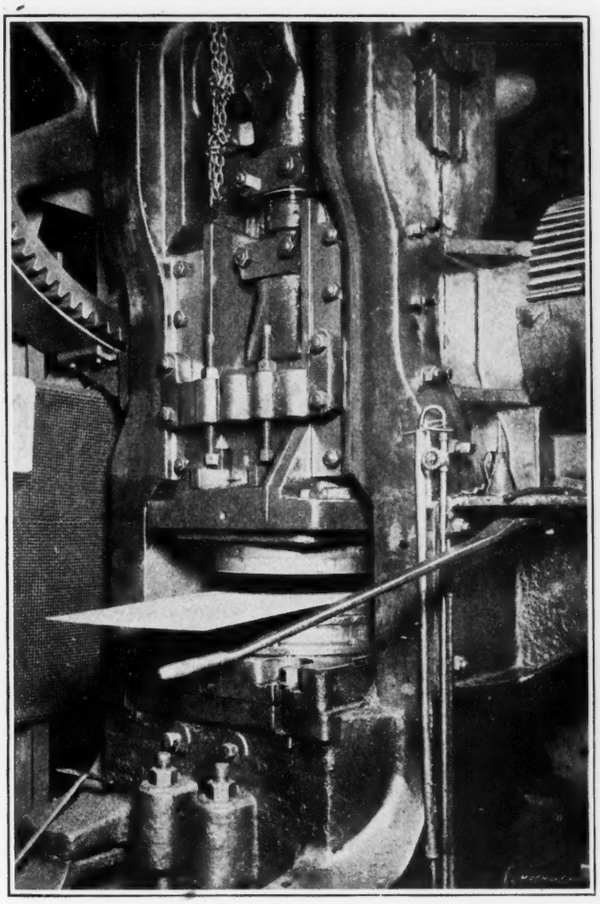


Fig. 2. No. 59 Toledo Power Press equipped with Combination Die for blanking and drawing the Barrel Heads

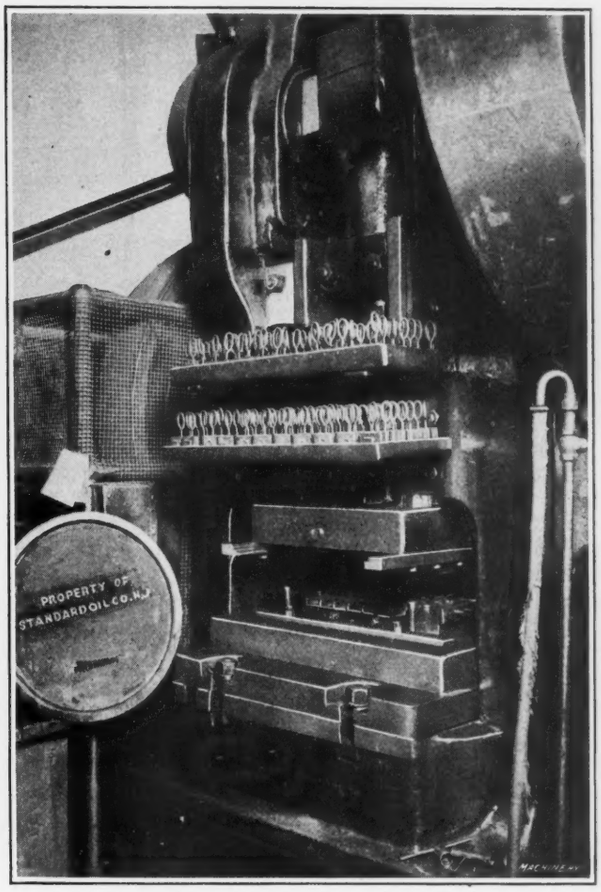


Fig. 3. No. 57 Toledo Power Press and Matthews Sectional Dies for embossing the Name, etc., on Barrel Heads

various other supplementary markings are also required. For this purpose use is made of special embossing dies made for that purpose by James H. Matthews & Co., of Pittsburg, Pa.

The idea for the design of these marking dies was obtained from the way in which a typesetter assembles type for printing; and the Matthews marking dies have the advantage in common with type—that they can be used over and over again in various combinations to produce any desired marking on the work. It will be apparent from Fig. 3 that these dies consist of steel blocks, each of which carries a number or letter of the desired size. These die sections are made in pairs, in one of which the letter or figure is in relief, while in the other it is cut into the face of the die. When used for marking barrel heads which have been blanked and drawn in the preceding operation, two sets of these die sections arranged to produce the required marking are set up in the die-holder on the press platen and in the holder carried by the ram of the press, respectively. The die sections with letters or figures in relief are mounted in the

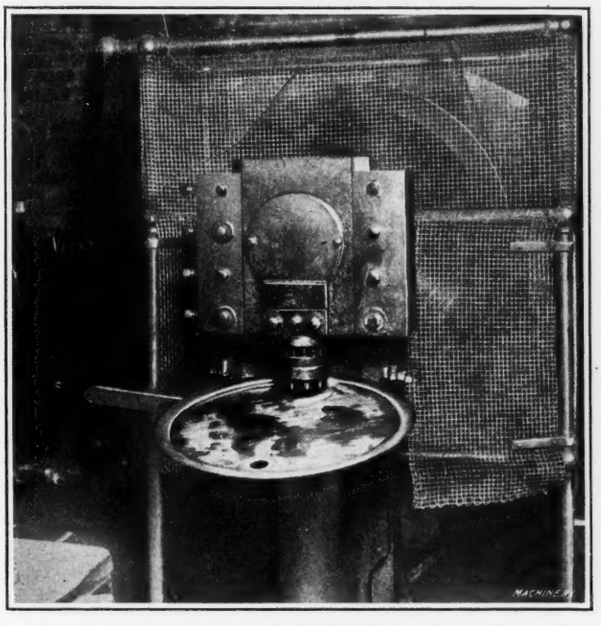


Fig. 4. Small Power Press equipped with Dies for piercing Bung Holes and drawing up Metal around Holes

Fig. 5. Electric Arc Welding Outfit made by C. & C. Electric Co. for welding Sockets into Head of Barrel

holder carried by the ram of the press, while the other set of die sections is placed on the machine platen and accurately located in alignment with the die sections carried by the ram. From this it will be apparent that after the blanking and drawing operation has been performed, these dies will emboss the marking upon the barrel head, the arrangement being such that this marking appears in relief. The No. 57 Toledo press used for the performance of this work is illustrated in operation in Fig. 3 which also shows the extra die sections carried in trays on the frame of the machine. It will be apparent to men who have had experience in the performance of embossing operations that as the letters are about ⅛ inch wide and it is required to emboss the marking to a height of 3/32 inch, a press which can successfully do this work on 12-gage steel will have to be of great strength and possessed of ample means for the application of pressure.

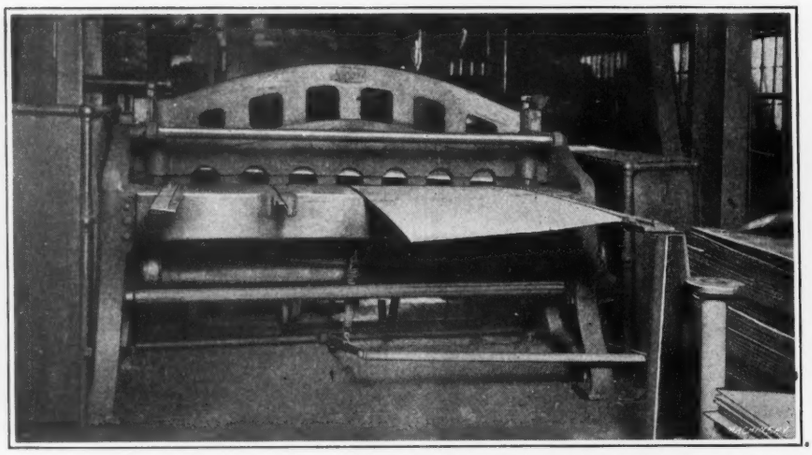


Fig. 6. Trimming Press built by George A. Ohl & Co., which is used for squaring up the Sheets from which Barrel Bodies are made

Piercing the Bung Holes in the Barrel Head

When the embossing operation has been completed, the barrel heads are transferred to a special power press, illustrated in Fig. 4, where two holes are pierced to receive the "spuds" or malleable iron sockets for the bungs. This is a simple blanking operation which is performed with dies arranged to draw up a slightly raised area around each of the holes.

Welding the Bung Hole Sockets into the Head

After piercing the holes in the manner which has just been described, the next step is to weld the spuds into place in the head. Fig. 5 illustrates the apparatus used for this purpose, which consists of an electric arc welding machine built by the C. & C. Electric Co. This is an ordinary welding operation, and consists merely of dropping the malleable iron sockets into place and welding them to the barrel head. The usual form of electrode holder is employed and the necessary amount of metal is added to the weld from a piece of Swedish iron wire that is carried in the electrode holder.

Making the Barrel Bodies

In connection with a discussion of the raw materials used in the steel barrel industry, it was stated that plates of 13-gage steel from which the barrel bodies are made come to the plant in sizes just large enough to make a complete barrel body. The only preparatory work necessary is to trim the edges of these plates under a squaring shear to be sure that they are accurate. The squaring shear used for this purpose was built by George A. Ohl & Co. of Newark, N. J., and is shown in operation in Fig. 6. After this has been done, the plates are transferred to a set of bending rolls built by the Niagara Machine & Tool Works of Buffalo, N. Y., and shown in operation in Fig. 7, through which they are passed to bring each piece into a cylindrical form. When this has been accomplished, the next step is to butt-weld the seam down the side of the barrel, and for this purpose use is made of a battery of special electric welding machines built by the C. & C. Electric Co. of Garwood, N. J. As shown in Fig. 8, these machines will be seen to consist of a frame in which the bent sheet for making the barrel body is clamped in such a way that the butt ends of the seam down the side of the barrel are held closely in contact with each other. It will be apparent from the illustration that this clamp is so arranged that a space *A* is left down the center, which is of sufficient width to provide for reaching through

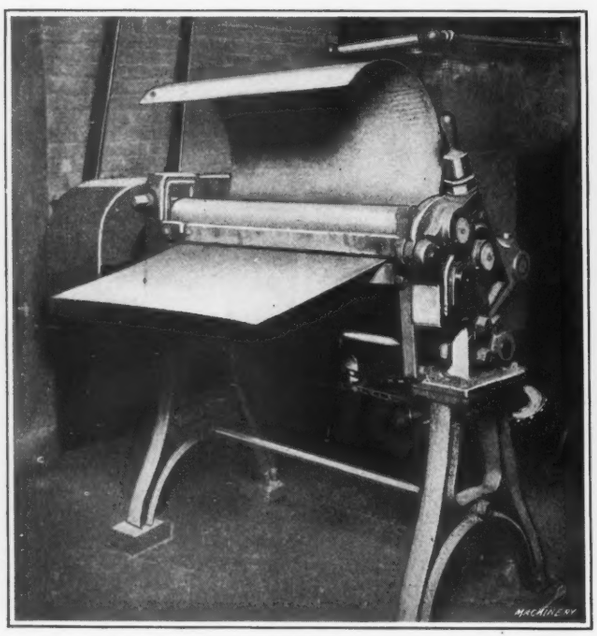


Fig. 7. Bending Rolls built by Niagara Machine & Tool Works for curving Each Sheet into a Cylindrical Form

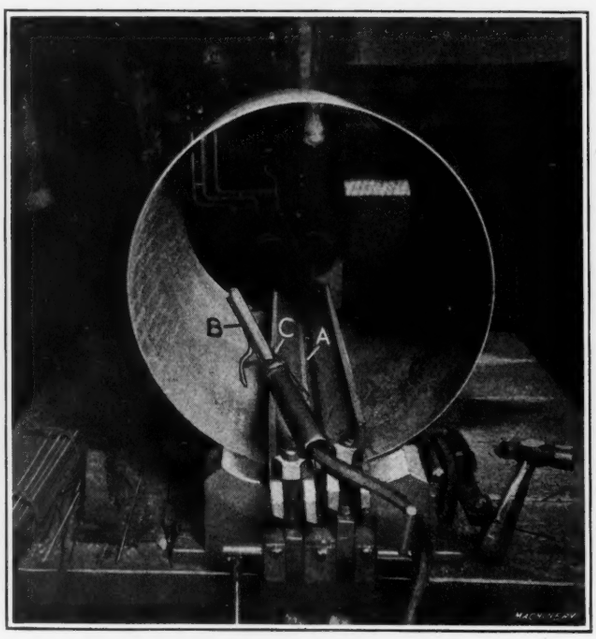


Fig. 8. Special Arc Welding Machine built by C. & C. Electric Co. for welding the Side Seam of the Barrel Body

to perform the welding operation. The base of the machine is connected to one terminal of the electric circuit so that the frame and the barrel held by it become one terminal; the other terminal consists of an electrode holder *B* in which is clamped a piece of Swedish iron wire *C*, ⅛ inch in diameter, the holder being furnished with a wooden handle, which is a non-conductor and so provides for the safety of the operator.

When the barrel has been clamped in place, application of the piece of Swedish iron to the joint results in closing

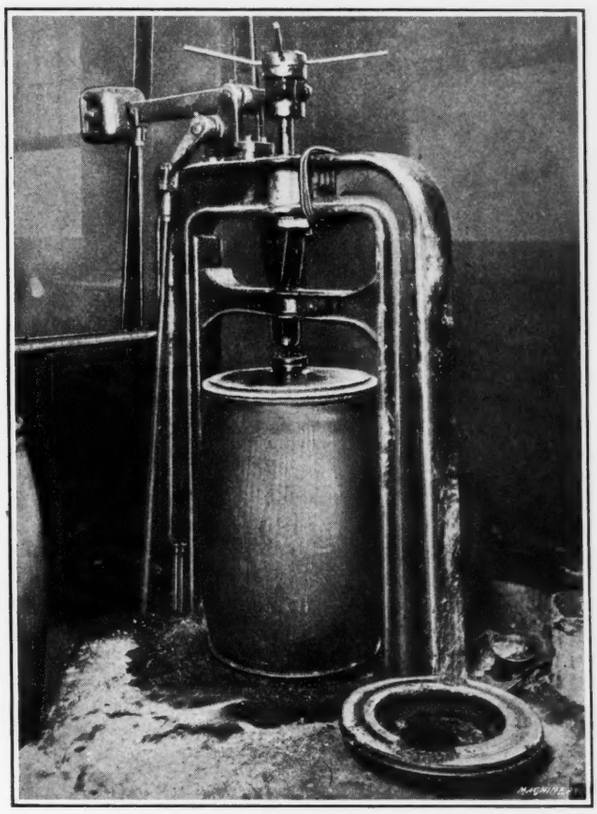


Fig. 9. Machine built by Charles Leffler & Co. for folding Edge of Head over Flange on Barrel Body

the circuit and melting the iron wire to make an addition of metal at the point where the welding is to be done. This is the familiar process of electric arc welding and requires no detailed description. In this connection, however, attention is called to the fact that a welder can only handle a piece of wire 8 inches in length, and as it requires approximately 8 feet of wire to complete the weld in a barrel body, it will be apparent that he must change his wire at least

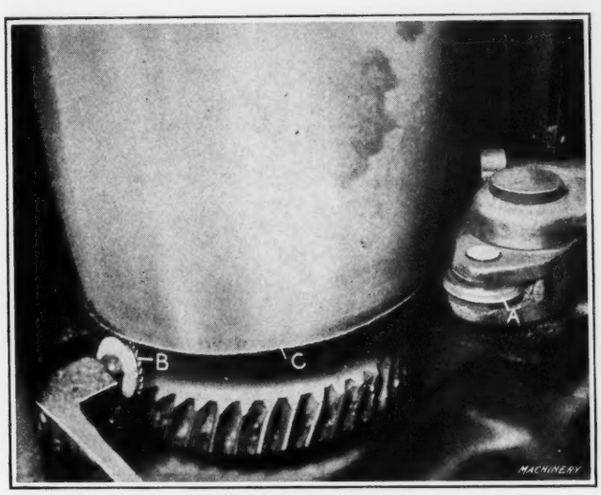


Fig. 10. Close View of the Two Rolls A and B on Leffler Machine for turning up Flange C on Barrel Body

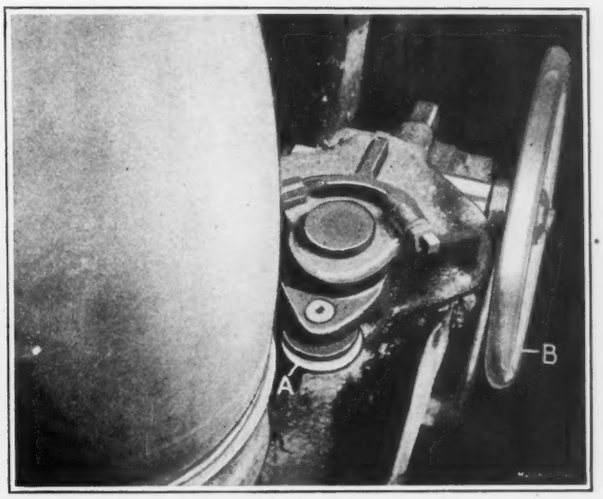


Fig. 11. Close View of One of the Two Rolls on Leffler Machine for folding Seam between Barrel Body and Head

twelve times. An experienced welder will produce a weld of practically the same strength as that of any other section of the steel, but in doing this work care must be taken each time the Swedish iron wire is changed and a fresh start made in the performance of the welding operation not to go back too far over the weld. Steel adjacent to the point of welding deteriorates rather rapidly, and in the event of heat being applied to the barrel body seam for a greater length of time than is required, there is a tendency for the steel adjacent to the weld to become crystallized which, in

Fig. 12. Oil-heated Brazing Furnace with Rotary Hearth, for brazing Barrel Head onto Body

turn, is likely to result in failure of the barrel at or near the weld during subsequent steps in the process of manufacture.

Flanging the Barrel Body and Folding the Periphery of One Head Over the Flange

After the welding operation has been completed, the next step is to form a flange at one end of the work, as shown at *B* in Fig. 1. This operation is performed on a rotary flanging machine built by Charles Leffler & Co. of Brooklyn, N. Y. When this operation has been completed, head *A* is dropped into place in the top of the barrel body and transferred to a second Leffler rotary flanging machine, shown in Fig. 9, which is equipped with a set of dies for folding flange *C* (see diagrams, Fig. 1) on the head over flange *B*

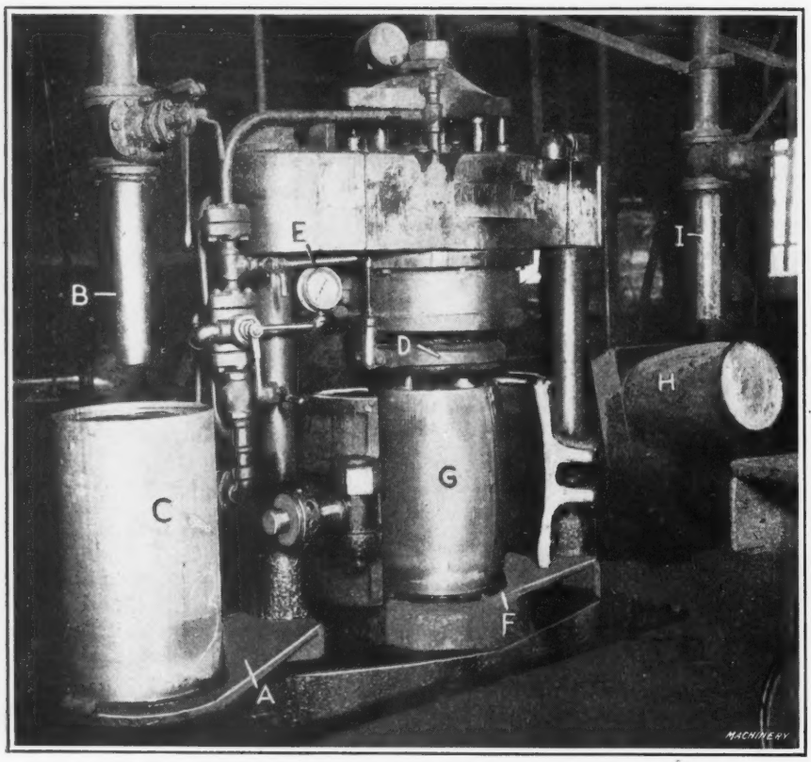


Fig. 13. Special Hydraulic Press built by R. D. Wood for forming Bilge on Barrel Body. This Illustration shows Barrel C filled with Water Ready for the Bilging Operation, Barrel G after the Bilge has been produced and the Form on the Press has been opened, and Bilged Barrel H having Water dumped out into a Drain

on the barrel body. A better idea of the way in which the flange is turned up on the body of the barrel will be gathered by reference to Fig. 10, which shows a close view of the mechanism provided for this purpose. The body of the barrel is dropped into place on a form, after which roller *A* is swung over by means of a suitable mechanism (which will be described in connection with Fig. 11) to force the metal at the extreme lower edge of the barrel body into close contact with the form over which it is carried, and thus start the work of bending up the flange. After the operation has progressed to this point the flange is completed by means of a corrugated roller *B* which is forced up under the flange that has already been started, and causes this flange to assume the condition shown at *C* in the illustration.

Fig. 11 shows the mechanism of the machine illustrated in Fig. 9, which is used for folding the edge of the barrel head over the flange on the body that is turned up on the machine illustrated in Fig. 10. It will be seen that on the seam-folding machine, Fig. 10, there is a roller *A*. In setting up the work on the machine, the barrel head, which is in the condition indicated at *A* in Fig. 1, is put on the table of the machine, after which the barrel body is dropped into place so that the head fits up into it. It is then the function of the seam-folding machine to bend flange *C* over flange *B* to bring the work to the condition shown in the center diagram in Fig. 1. To accomplish this result, handwheel *B*, Fig. 11, is turned, rotating a worm that meshes with a worm-wheel segment on the pivoted bracket on which roller *A* is mounted. This roller is caused to move over against the edge of the flange on the barrel head. Through the action of the roller *A*, and also that of another roller (not shown in the illustration) which engages the work before roller *A* comes into contact with it, the edge of the head is folded over the flange on the barrel body.

Brazing the Head onto the Barrel Body

Experience in the manufacture of steel barrels has shown that it is far more desirable to braze the heads onto the body than to weld them in place. The reason for this is that if the head of a barrel becomes damaged, it is an easy matter to remove it and substitute a new one if the joint has been made by brazing; but if the joint were welded, such a repair could not be made and so it would be necessary to throw away the whole barrel. In preparing for the performance of the brazing operation, the work is started during the time that the seam is being folded on the machine illustrated in Fig. 9. The operator of the seam-forming machine introduces brass and the necessary flux into the joint, so that the work is ready to be brazed after it leaves the seam-folding machine. The brazing operation is performed in an oil-heated furnace equipped with a rotating hearth. Such a furnace is shown in operation in Fig. 12, and here it will be seen that near the top of the barrel there are two long handles. The reason for using these handles is that when the seam filled with brass and flux is heated, this material becomes molten and if care were not taken to keep the barrel in a perfectly vertical position while it was being lifted from the furnace, the molten brass would run out. During the process of brazing it is necessary to add additional flux and sometimes additional brass in order to produce a good joint.

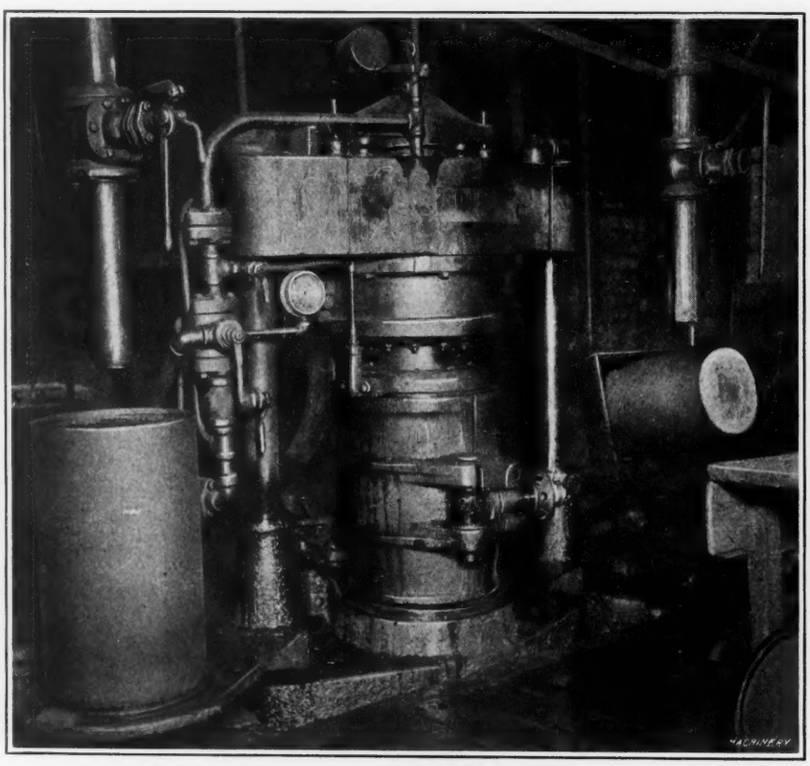


Fig. 14. This Illustration shows the R. D. Wood Hydraulic Bilging Press with All Equipment in the Same Positions as shown in Fig. 13, except that the Form on the Bilging Press is closed Ready for Operation

Performance of the Bilging Operation

The condition of the work is now as shown by the center diagram in Fig. 1. As will be seen the body of the barrel is a straight cylinder, and the next step required in the process of manufacture is to perform what is known as the "bilging" operation, which brings the body of the barrel to the form shown at *C* in Fig. 1. For this purpose the barrel is taken to a special hydraulic press built by R. D. Wood & Co., of Philadelphia, Pa., and set up on a swinging bracket *A* (Fig. 13), with the head of the barrel down. The barrel is next filled with water from pipe *B*, after which the bracket swings it into position in the bilging fixture. It will be seen that this is essentially a form, the diameter of which at the top and bottom is that of the cylindrical shaped barrel body when in the condition shown at *C*, while the sides of the fixture have the desired amount of bilge which is required on the barrel when completed. At the top of the fixture there is a plunger *D* with an annular groove of the same diameter as the straight cylindrical barrel body. This plunger descends into place on the top of the barrel and the packing in the groove serves to make the joint water-tight. The pumps on the press are now started and deliver additional water into the barrel under pressure, with the result that the barrel is expanded to completely fill the bilging fixture. Obviously as this operation proceeds, the upper edge of the barrel will be drawn down as the steel is expanded sidewise. To take care of this contingency, the ram which fits the top of the barrel is also arranged to descend so that the joint is always maintained water-tight. The operation is started under a water pressure of about 450 pounds per square inch, as shown by gage *E*, and this is gradually increased until the maximum of 750 pounds per square inch is attained, when the form of the barrel corresponds to that of the form on the press.

It will be seen that in addition to the bracket indicated at *A* at the left-hand side of the bilging press, there is a second bracket *F* which supports the barrel *G* on which the bilging operation has just been completed. Before barrel body *C* can be moved into the press, bracket *F* will be swung to the right to make room for bracket *A* to carry body *C* into position in the fixture. After swinging it out of the press, barrel *G* will be dumped into a sink, as indicated by the position of the barrel *H*, and then a new barrel body will be placed on bracket *F* and filled with water from supply pipe *I*. From this description it will be apparent that the operator can spend his time dumping water out of the bilged barrel body and filling a new barrel with water while the bilging operation is being performed on a body held in the press.

Fig. 15. Two of the Pickling Tanks in which Barrels are dipped first into Sulphuric Acid and then into Caustic Soda to strip Scale off the Steel preparatory to galvanizing

Putting the Top Head in the Barrel

In putting the top head into place, use is made of a second pair of Leffler rotary flanging and seam-folding machines, which are of exactly the same design as those already described, and the operation varies in no respect from that of placing the lower head in the barrel. After this head has been put in place and flanged over, the barrel is again taken to a brazing furnace and the upper head is brazed onto the body.

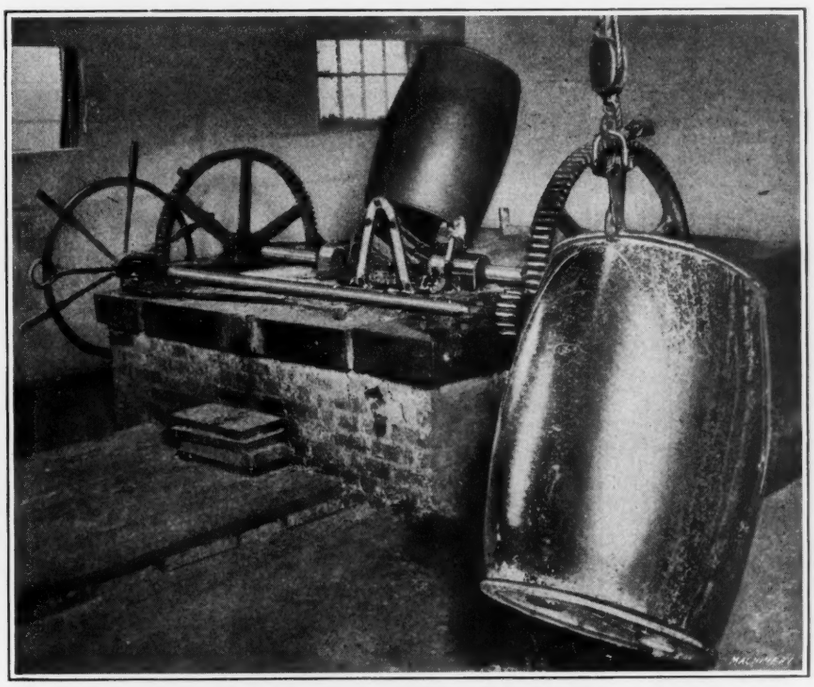


Fig. 16. In this Illustration are shown One Barrel which has just been removed from the Galvanizing Bath and hung up to allow the Last of the Melted Zinc to drain out through the Bung Hole, and Another Barrel secured in the Clamp Ready to be immersed into the Molten Zinc by turning the Pilot Wheel

Pickling and Galvanizing

Steel barrels are expected to give service through a life of considerable duration, and in order that they may live up to this requirement, it is necessary to protect the steel from rust and corrosion. This is done by a process of galvanizing. In galvanizing the steel barrels—as in the application of any form of galvanizing or welding process—it is necessary to have the metal chemically clean and particularly to have all traces of oxide, rust, oil, and grease removed from its surface. This is done by first dipping the barrel into a pickling tank containing a 5 per cent solution of sulphuric acid, as shown in Fig. 15, which provides for stripping off rust and oxide scale from the metal. The theory of this operation is rather interesting, namely, that the acid acts upon the steel and liberates hydrogen gas under the scales of oxide and rust, the pressure of this gas eventually becoming sufficient to strip the scale from the metal. After immersion in the acid bath for a period of about five or six minutes, the barrel is

taken out and dipped into a tank containing caustic soda, which removes all oil and grease. The barrel is then removed from this tank and thoroughly rinsed in a tank of cold water to wash off any trace of caustic soda which may adhere to the barrel after being lifted out of the second pickling tank.

The barrel is next taken to a furnace where it is thoroughly dried, after which the galvanizing operation is performed by dipping the barrel into a tank of molten zinc, as shown in Fig. 16. Here it will be seen that the fixture consists of a clamp in which the barrel is secured with the head end up, after which the pilot wheel at the left-hand side of the machine is turned, to swing the clamp around its pivotal support and immerse the barrel in the bath of molten zinc. Care is taken to immerse the barrel with the head end up, so that after immersion the melted zinc will be able to flow in through the bung holes in the barrel and galvanize the inside as well as the outside. There are two important points to be observed in the performance of a galvanizing operation by this method; the temperature of the zinc must be just right, and the work must not be left in the bath any longer than is necessary to provide for its complete immersion and the filling of the barrel with zinc. The reasons for this are as follows: First, if the temperature of the zinc is above the required figure of 800 degrees F., there will be a tendency for it to oxidize and assume a condition which is adverse to a speedy union of the zinc with the steel barrel. As regards leaving work in the bath for the minimum length of time, the reason is that the shorter the time the work is immersed the more zinc there will be attached to it, because as the temperature of the barrel is raised, the zinc in contact with it becomes more fluid and thus drains off when the barrel is lifted from the bath. After being galvanized, the barrel is hung up with one of the bung holes in the lowest position, as shown in the foreground of Fig. 16, so that the last traces of liquid zinc held in the barrel are given an opportunity to drain out.

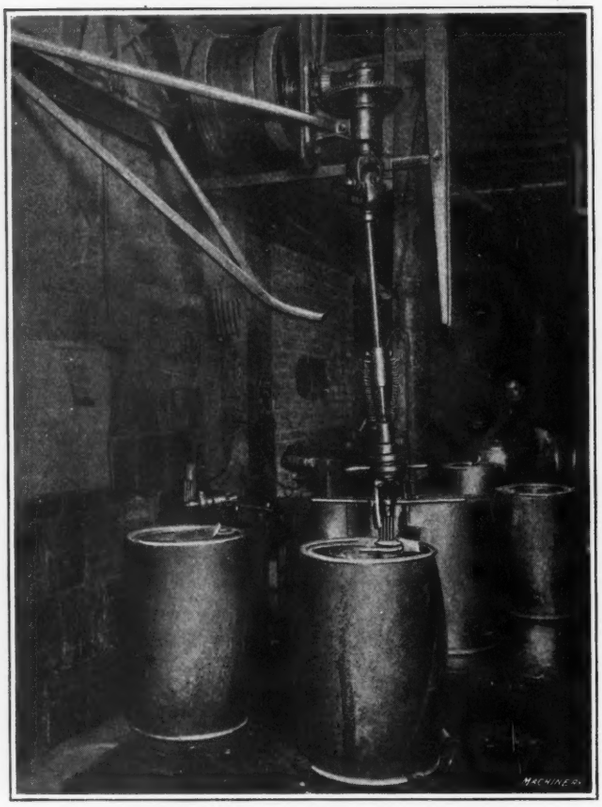


Fig. 17. Special Machine used for performing Reaming, Facing, and Tapping Operations in Bung Holes

Reaming, Tapping, and Facing the "Spuds" or Bung Sockets

After galvanizing it is necessary to ream and tap the malleable iron sockets in the head ready to receive the bungs and also to face the tops of these sockets to form a good bearing for each of the flanges on the two bungs. This is done on a special machine illustrated in Fig. 17, which is of such a simple form that little description is required. It consists merely of a bevel gear drive and universal joint which transmit motion down to the reamer, tap, and facing tool which are used for the successive machining operations. It will be seen that a double set of tight and loose pulleys provides for reversing the direction of rotation of the spindle for the tapping operation.

Final Inspection and Testing of the Barrel Capacity

In order to meet the requirements of the Interstate Commerce Commission, steel barrels used for carrying oil must be tested under an air pressure of 15 pounds per square inch. Obviously this test calls for barrels which are absolutely oil- and water-tight, as air would easily leak out of the most minute opening and prevent the required pressure

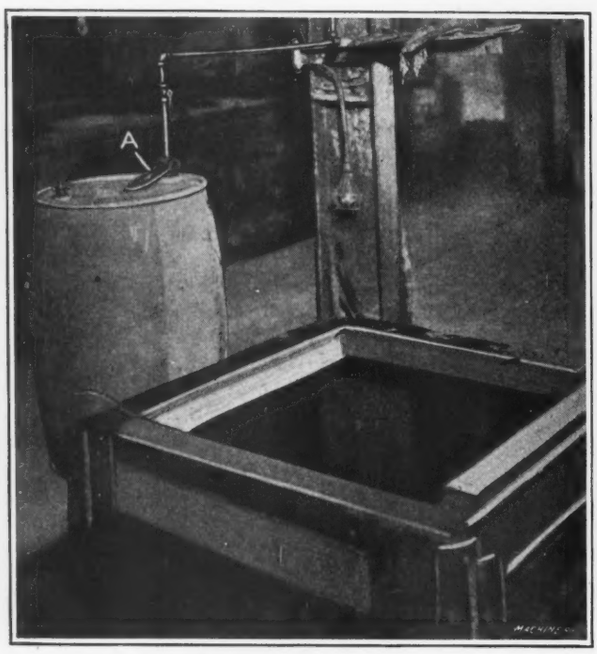


Fig. 18. Testing the Barrel under Air Pressure of 15 Pounds per Square Inch to determine Freedom from Leaks

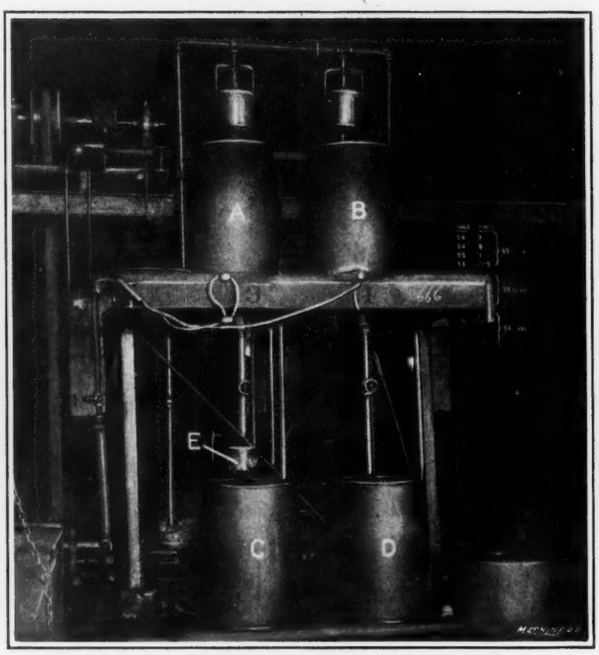


Fig. 19. Testing Capacity of Barrels and marking them with the Exact Volume which Each One Contains

from being maintained. Fig. 18 shows the apparatus in which the pressure test is conducted. One of the bung holes is plugged and the other is provided with a special valve through which connection is made with an air pressure line in which the air is at a pressure of 15 pounds per square inch. After the desired pressure has been built up in the barrel, valve handle *A* is manipulated to break the connection between the barrel and the pipe line and hold the pressure in the barrel, and then the barrel is tested with water around the seams of both heads and down the side seam. If there is any leak it will be evidenced by air bubbles.

After making this test, valve *A* is removed and the barrel is sent to a capacity testing apparatus which is shown in Fig. 19. This consists merely of running the contents of one of the "standard" barrels shown at *A* or *B* into the barrel *C* or *D* which is to be tested. The volume contained in the standard barrel has been accurately calibrated. After the contents of the standard barrel have been run in, any excess capacity is filled up by adding water through the funnel *E* with a half-gallon measure. The man in charge of this work then stamps the capacity of the barrel into the edge of the spud, using an ordinary metal stamp for this purpose, and the barrel will then have a label soldered onto its head, showing the exact volume of liquid which it is capable of holding. When this volume test has been completed, the final work of inspection consists of putting a suction hose in through the bung hole of the barrel and moving it around to provide for drawing out any particles of dust or metal chips, etc., which have been left in the barrel. After this work has been accomplished, the tag is put on and the barrel is ready for shipment.

In addition to the regular routine tests to which all barrels are subjected, barrels are taken at specified intervals and given unusually severe tests, such as dropping them from a considerable height in various positions, including flat on the head, flat on the side seam and at an angle on the joint between the head and body of the barrel. Under such severe conditions of handling, it is evident that barrels which were not made of the best materials and produced by thoroughly trained workmen would fail very rapidly. The actual experience is, however, that such tests can usually be made without any of the seams or other sections of the barrel showing any damage beyond an ordinary blemish. It is evident that under normal conditions of service these barrels would be capable of lasting for a number of years.

* * *

A USEFUL MECHANISM FOR POWER PRESS FEEDS

BY GEORGE M. BARTLETT

The mechanical movement here illustrated and described was devised by the writer several years ago in order to solve the problem of converting the rotary motion of the crankshaft on a power press into an adjustable oscillatory motion for feeding parts into the periphery of a rotating dial plate and at the same time actuating the ratchet and pawl to rotate the dial plate. The mechanism, as shown in Fig. 2

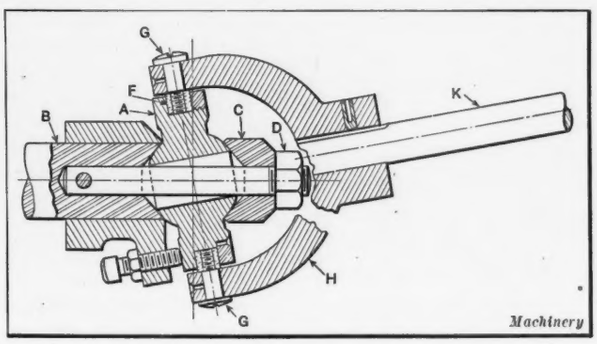


Fig. 1. Horizontal Section through Center Line of Crankshaft, with Yoke H turned to lie in Plane of Paper instead of at Right Angles to it

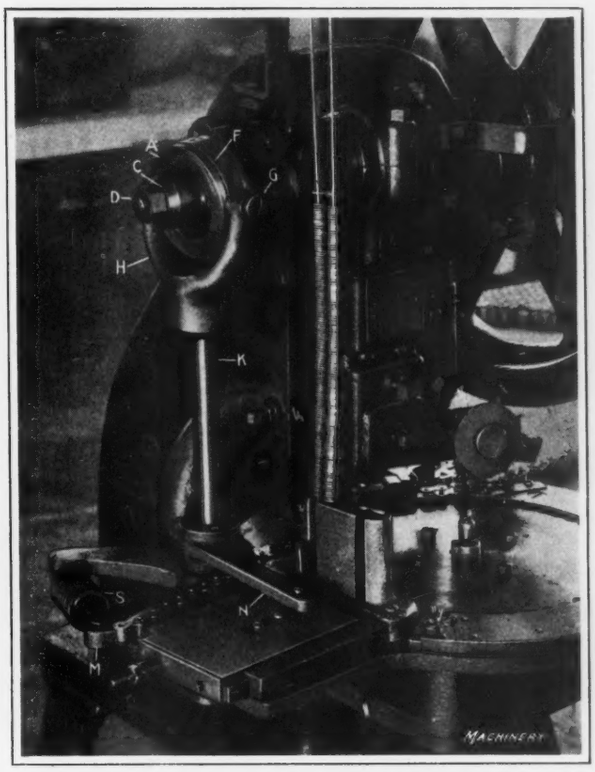


Fig. 2. A Useful Mechanism for actuating the Feed on a Power Press

consists of a disk *A* with a spherical shaped hub which can be clamped at any desired angle to the crankshaft, the end of which has a conical recess to receive the spherical hub. A washer *C* with a similar conical recess presses against the other side of the spherical hub, and is tightened by the nut *D*. A circular groove in the periphery of the disk carries a bronze ring *F* which has a free sliding motion around the groove. At diametrically opposite points on this ring, there are two pins *G* which connect the ring with the yoke *H*. The vertical rod *K* oscillates in a bearing at its lower end and carries two arms *M* and *N*. One arm gives motion to a pawl (not visible) which rotates the dial past one notch for each stroke of the press. The other arm operates a slide which feeds the article to be operated upon into the periphery of the dial plate during each backward motion of the pawl, that is, while the dial plate is stationary. The spring *S*, which is seen near the lower end of the vertical rod, is provided merely for safety. It does not act unless some accident prevents the dial plate from turning.

The construction of the mechanism which causes the oscillatory movement of the vertical rod is shown more clearly in Fig. 1, where a horizontal section through the center line of the crankshaft is shown, and the yoke is turned so as to lie in the plane of the paper instead of at right angles to it. This is done merely to bring all parts into one view. An inspection of this illustration will show how, as the crankshaft *B* rotates, the disk *A* is given a wobbling motion, and the ring *F*, which is prevented from turning with the shaft, will slip through the groove, giving to the two yoke pins *G* an oscillatory motion through a short circular arc, and transmitting the motion through the yoke *H* and the vertical shaft *K* to the levers below. The amplitude of this motion is regulated by changing the angle at which the disk is tilted with respect to the crankshaft. The character of the motion produced by this device is "simple harmonic," and the mechanism may have a variety of applications to power press feeds as well as to other automatic operations.

* * *

The Isle of Pines promises to become an important producer of iron, copper, and other ores. Eleven mines have already been located, though only two as yet are being actively developed.

Special Tools for Shell Manufacture

Second of Two Articles Describing a Number of Interesting and Ingenious Devices Used by the Buffalo Pitts Co.

By GEORGE A. NEUBAUER[1] and ERIK OBERG[2]

THE preceding installment of this article dealt with the operations on the shell preceding the heat-treatment. The present installment deals with the cooling system for the quenching oil—a system applicable to any commercial line of manufacture—and treats also of some of the many ingenious tools and gages that have been designed in the making of war materials. The experience gained by manufacturers in machining shells will prove valuable in many lines of interchangeable manufacture where mass production is the important factor.

Cooling System for Oil

For the cooling of the quenching oil an interesting system is employed. Fig. 8 shows in diagrammatical form the lay-out of this system. The oil passes from the quenching tank to a hot well or oil sump *A* by gravity. From this oil sump it is pumped for cooling through ring coils of 2-inch pipe, this device being placed in a large wooden tank *B*. From this tank the oil flows to a storage tank *C*, having a capacity of 6000 gallons, and from this storage tank the oil passes back to the quenching tank by the action of another pump. The cooling pipes located in the tank *B* are arranged in four coils which are connected in parallel, as indicated in Fig. 9. The length of each of these coils is 240 feet so that the oil passes through 960 feet of pipe for cooling. It is possible, however, on account of this arrangement of the piping to control the temperature of the oil in the quenching tank, as by closing off one or more of the coils and forcing all the oil through the remaining coils, a different degree of cooling may be obtained. This is accomplished in the following manner. The pump forcing the oil through the coils has a capacity of 200 gallons per minute and is positive. Hence, if three coils are shut off, 200 gallons of oil per minute must pass through one coil. This means that the speed of the oil through the coil must be much more rapid than if all four coils were opened, and hence the cooling effect will be less. The result is that the temperature of the oil can be accurately controlled by passing it through a greater number of coils according to the greater temperature drop required.

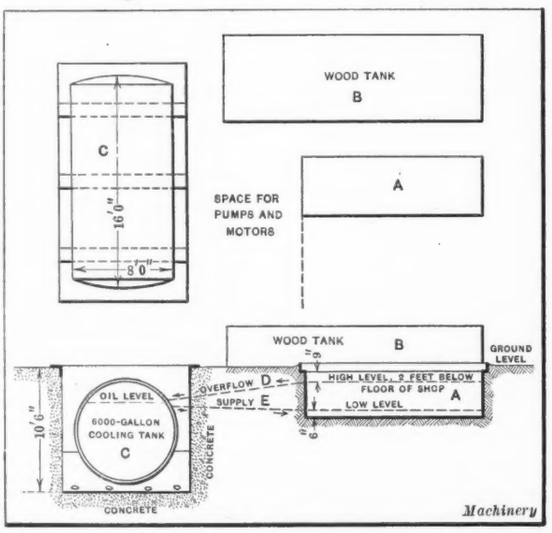


Fig. 8. Lay-out of Cooling and Storage System for Quenching Oil

An interesting system which might be called an interlocking scheme is used for preventing any difficulties from arising in case either of the pumps used in connection with the cooling system and quenching tank should fail to operate properly. As mentioned, there is one pump that brings the oil from hot well *A* to tank *C* through the cooling system *B*, and another pump that brings the oil from the storage tank *C* to the quenching tank. Should either pump fail, circulation will still continue by gravity, as valves are provided which are automatically opened to permit the oil to flow by gravity between the different tanks. For example, assume that the pump bringing oil from *A* to *C* should fail to operate; this means that the oil in hot well *A* will rise, while the oil level in tank *C* will fall. When the oil level in hot well *A* reaches a high level two feet below the floor of the shop, a valve to an overflow pipe *D*, Fig. 8, is reached, and the oil will flow by gravity through this pipe and the circulation will thereby be maintained. Should the pump leading from the tank *C* to the quenching tank fail, the pump from *A* to *C* would still operate and would have a tendency to empty hot well *A* which would not be supplied from the quenching tank, while tank *C* would be filled above the proper level. In that case, when the oil level in *C* rose above the low level six inches above the bottom in tank *A*, supply pipe *E* would open up and oil would be carried from *C* to *A*.

For Operation 11—annealing—a Frankfort furnace is used. The annealing temperature is from 1200 to 1250 degrees F. according to the chemical composition of the steel in the shells. The time for annealing is fifty minutes. Tests are made of a few shells of each heat to determine accurately the temperatures required for heat-treatment. Three hardening furnaces and four annealing furnaces are used.

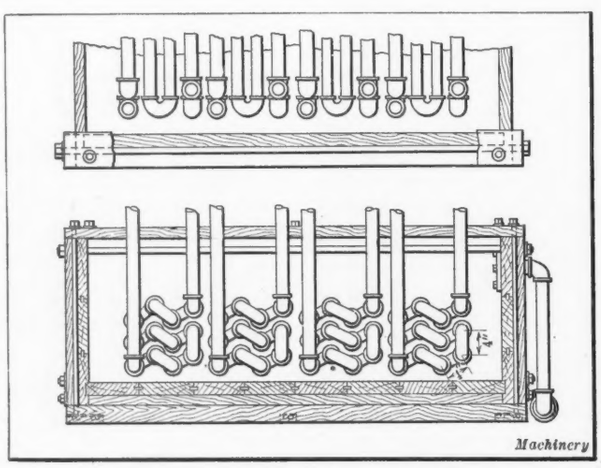


Fig. 9. Arrangement of Pipe Lines for cooling Oil

Remaining Operations for Finishing the Shell

The machining operations immediately follow and are comparatively simple, and the tools used for them are similar to those used in prac-

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[2]Editor of MACHINERY.

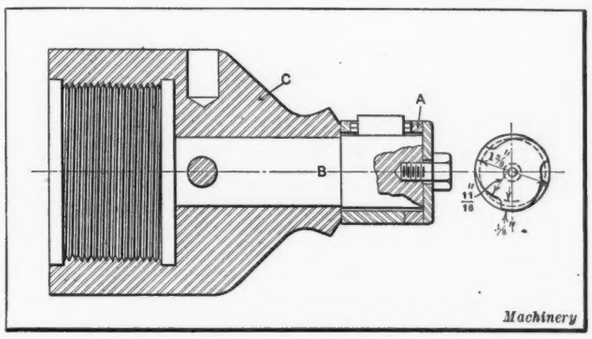


Fig. 10. Roller Chuck used for the Second Outside Turning Operation

tically all other plants machining similar shells. For the boring of the fuse hole (*I*, Fig. 1)—Operation 12—six machines are provided, and for the re-turning of the outside of the shell—Operation 13, (*J*, Fig. 1)—four machines are used.

ing operation, these lathes being provided with a special profiling attachment for this work. This attachment is shown in Fig. 11. A profile bar *A* is provided, against which a roller suitably held in the tool-slide rolls so that the slide is moved forward along the shell to form the shape of the nose. A counterweight is provided at the back of the lathe as indicated, for forcing the tool-slide against the profile bar. One toolpost is used for turning the profile, while the other toolpost turns the straight part of the shell.

Operation 14, (*K*, Fig. 1)—finish-turning and profiling—is performed by a form profiling tool to shape the nose, while the straight part of the shell is turned in the ordinary way. Seven machines are provided for this operation.

Operation 15, (*L*, Fig. 1)—cutting the recess at the back of the thread in the fuse hole—is performed by a special recessing device as shown in Fig. 16. The recessing tool *A* is held in a slide *B*, the projecting part of which, after having entered the fuse hole is fed in to form the recesses until the slide comes against stop *C*. Only one machine is

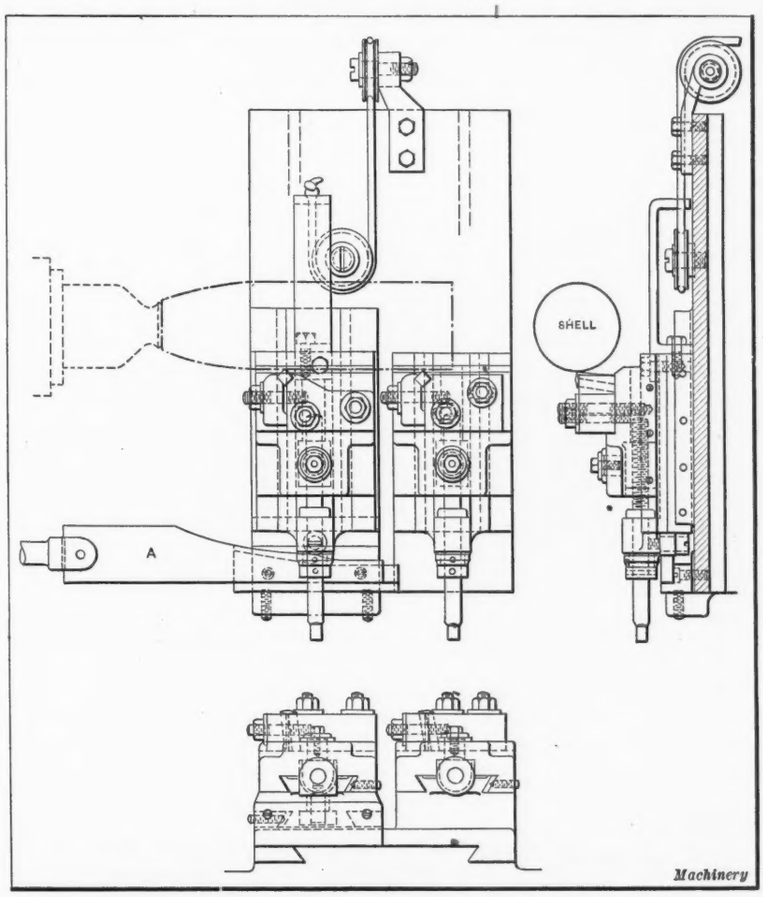


Fig. 11. Profiling Attachment used for rough-turning the Nose of the Shell

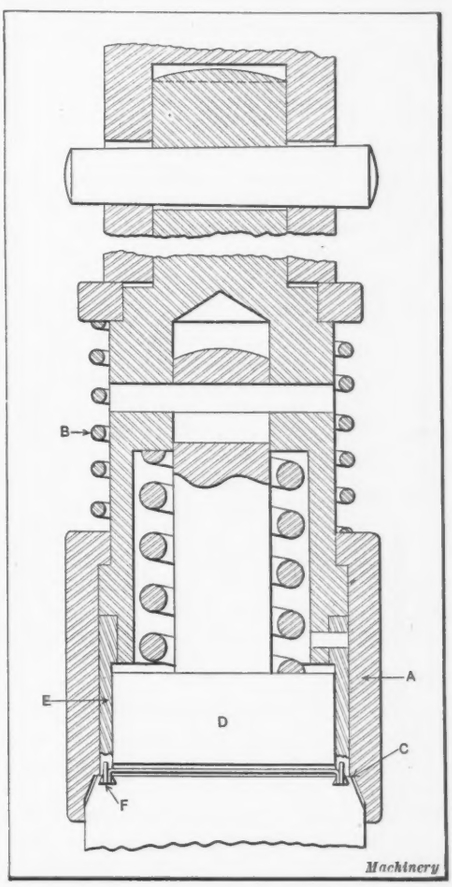


Fig. 12. Die used for riveting Base Cover into Position in End of Shell in an Arbor Press

In this re-turning operation a roller chuck, as shown in Fig. 10, is used for holding the shell by the fuse hole previously bored. The body of this chuck is screwed onto the lathe spindle, and the end of it is provided with a bushing as indicated, holding three hardened tool-steel rollers. The bushing or roller retainer *A* is made from machine steel, but the shank *B* against which the rollers bear, is made from tool steel, hardened and ground. Cam surfaces are cut into the end of this shank so that the shell will be firmly gripped by the rollers as they roll upward along the cam surfaces and thus become wedged between the inside of the fuse hole and shank *B*. The body *C* of the chuck is made from machine steel.

Putnam lathes are used for the re-turning operation required for taking care of the shop's capacity for this operation.

A number of the following operations present no new methods. For the grinding of the bourrelet two machines

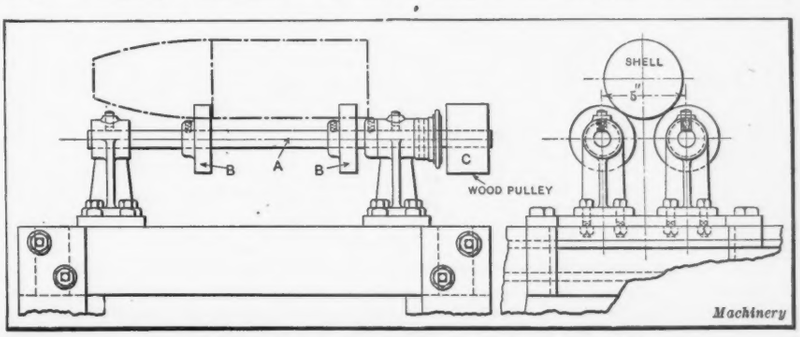


Fig. 13. Device for rotating Shells for cleaning and varnishing

are provided; for the cutting off of the base projection, two machines; for the swiping of the inside, two machines. One scale only is necessary for the weighing of all the shells. The facing of the base requires three machines and the cutting of the band and crimping groove, and also the cutting of the base cover groove, the same number. The knurling, the milling of the stabbing groove, and the reaming of the fuse hole require only one machine each. Five thread millers are provided for the milling of the fuse thread, and four sand-blasting machines for the sand-blasting operation. For pressing the copper band in place two West tire setters are used, and two machines are required for turning the copper band.

A special fixture is used for holding the shell in Operation 24 while milling the stabbing groove (*T*, Fig. 2). This fixture, as shown in Fig. 14, consists simply of a baseplate *A* with projections at both ends, and vees *B* and *C* for supporting the shell. The shell is located by a projecting lug *D* at the open end and by six V-supports at the other end. It is clamped by a handwheel as shown, operating against a wooden shoe. The fixture is placed on the table of the milling machine and fed against the milling cutter which mills the indentation at *E*.

An unusual method is used for Operation 32 (*Z*, Fig. 2), that of riveting the base cover in position. Here a No. 9 Greenerd arbor press operated by hand is used. By means of a four-foot handle applied to this press, one man can obtain a 20-ton pressure at the operating point. Fig. 12 shows the die used in the arbor press. Sleeve *A* held down by spring *B* first reaches the shell and centers it with the die. A small shoulder at *C* rests upon the end of the shell, holding it firmly. As the plunger descends, its central part *D* is brought down. This presses the copper cover firmly against the end of the shell in the center. Finally, continued pressure brings down the die *E* which squeezes the lead wire *F* into the dovetail groove, and thereby rivets the copper cover in place in the recess. One arbor press is sufficient to take care of the complete output of the company.

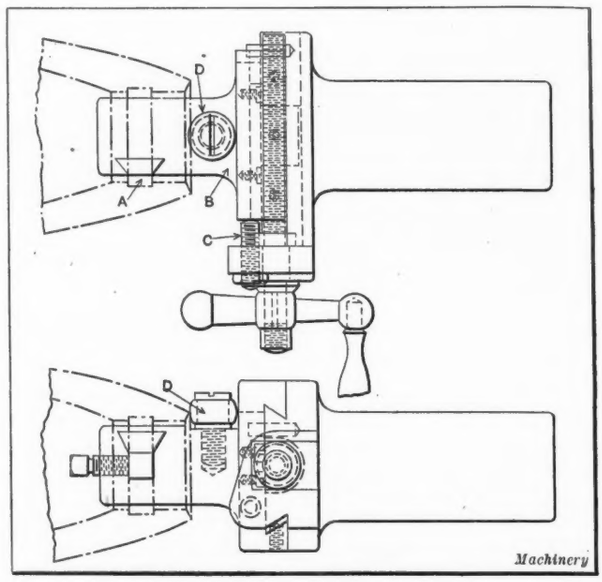


Fig. 16. Recessing Device used for cutting the Recess back of the Thread in the Fuse Hole

Fig. 13 shows a simple device for rotating shells for cleaning, varnishing, or any other operation where it is convenient to have a device for turning the shells around. It consists simply of four uprights provided with bearings for shafts *A*, which, in turn, carry rollers *B* and pulley *C*, the latter being made of wood. This pulley may be driven from the lineshaft so that the rollers will rotate the shells. The device is simple and may be moved to different parts of the shop according to the requirements.

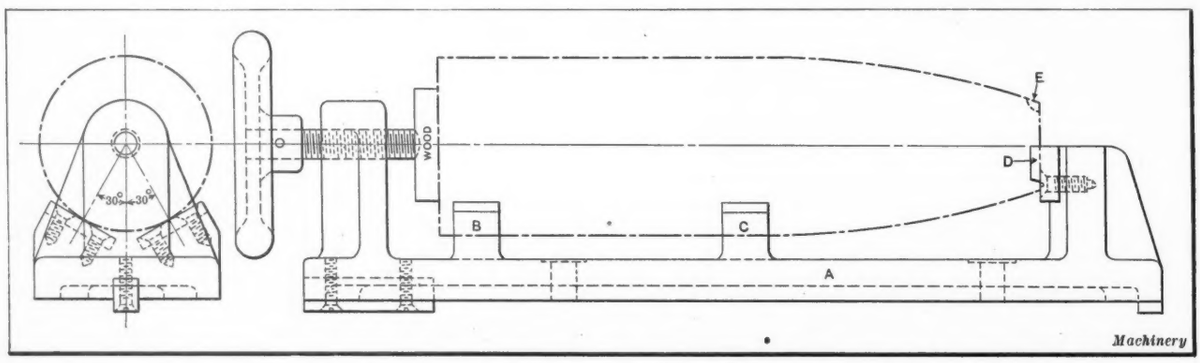


Fig. 14. Fixture for holding Shell while milling the Stabbing Groove

Special Gages Used

The gages employed in the inspection are nearly all of the same design as furnished by the Government, and are known to all shell manufacturers. Hence, they will not be described here. A few gages, however, are of special construction and have been adapted from gages used for similar purposes by the Buffalo Pitts Co. One of these is shown in Fig. 15, this gage being used for checking the wall thickness. As shown, it is provided with an extension at *A*, which bears against the bottom of the shell so as to insure that the gaging at *B* is done at the right height. An indicating pointer then shows on a scale whether the thickness of the wall is between the required limits. The two marks shown at *C* are for the wall thickness at *B*, while the two marks shown at *D* are for the wall thickness at the bourrelet.

Another interesting gage, shown in Fig. 17, is used for determining the concen-

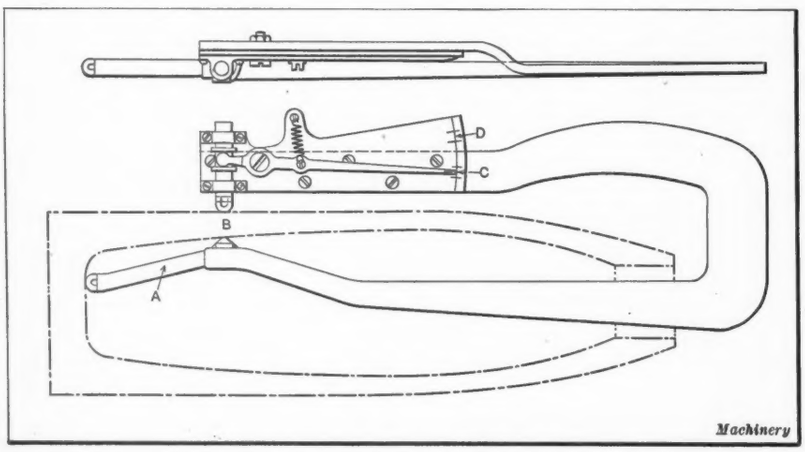


Fig. 15. Gage for checking the Wall Thickness

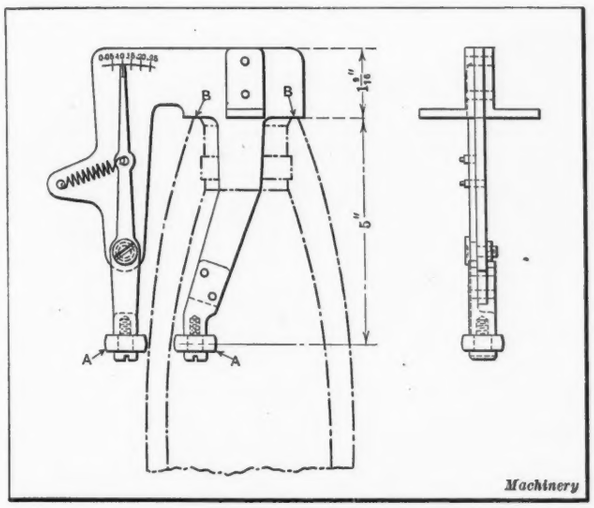


Fig. 17. Gage for checking the Concentricity of the Shell

tricity of the shell. The gage is provided with rollers at *A* as shown, while it rests at *B* on the top of the shell. As the gage is swung around the shell with the roller on the inside in contact with the inside wall, the roller on the outside, which is mounted on the end of an indicating lever, will, by its movement, cause the point of the indicator to show on a scale to what extent the outside of the shell is eccentric with the inside.

Fig. 18 shows a gage which is used after the base has been faced in Operation 20, and which is also employed in the preliminary government inspection. This gage measures the thickness of the base by the position of plunger *A* and the location of a line *B* on this plunger, in relation to two marks *C* on the gage frame. The gage is centered in position by V-clamps at *D*.

Shipping

The packing of the shells in the cars is, in itself, an interesting procedure, and considerable thought has been given to the different methods by means of which they could most satisfactorily be shipped. Fig. 19 shows a method of packing shells directly in box cars without placing them in cartons; this method has been found very satisfactory and has been approved by the Government as the best method for shipping shells of this type. As will be seen from the diagram indicating the method of loading the shells, alternate layers are placed with their noses in different directions, so that the copper band of the layer above comes opposite the open or waste space produced by the curvature of the nose of the layer of shells below. In this way, the copper bands do not touch the metal of the shells on the layers above or below. When packed in this way, it is reported that the cars with the shells are received at the loading plants in good condition.

The present installment of this article concludes the description of the special tools used at the Buffalo-Pitts Co.

COMPARISON OF HARDNESS TESTS

In a paper read before the Iron and Steel Institute of Great Britain, J. J. Thomas of the Watertown Arsenal, Watertown, Mass., stated that the relation between Brinell ball tests and scleroscope readings has brought forth many inquiries regarding the proper factor of conversion. Few manufacturers possess both testing instruments, and in order that a comparison may be made with the product of other factories, or to enable a comprehensive understanding of the results given in various trade journals, it is necessary that this factor of comparison be determined.

Results from over 500 readings of Brinell impressions made with an "Alpha" machine having a steel ball 10 millimeters in diameter, at 3000 kilograms pressure for 30 seconds, and results of scleroscope readings on an instrument having a diamond tipped hammer, each showed varying relative hardness for different materials. For steel the factor is 6.67; that is, the scleroscope reading multiplied by this factor gives the Brinell hardness number. The factor for cast iron and bronzes is 5.25; for aluminum, it is about 6; and for nickel steel, 7.7.

Considerable variation is found even in the same metal, the scleroscope readings varying more than the ball tests. This is probably due to the fact that the scleroscope measures the hardness of very small areas, which would very likely show a greater variation than is indicated when the areas are tested by the ball impressions. Hardness numbers above 300 Brinell and 45 scleroscope indicate metal difficult to machine. It is believed that each testing instrument has its own place in the testing of materials.

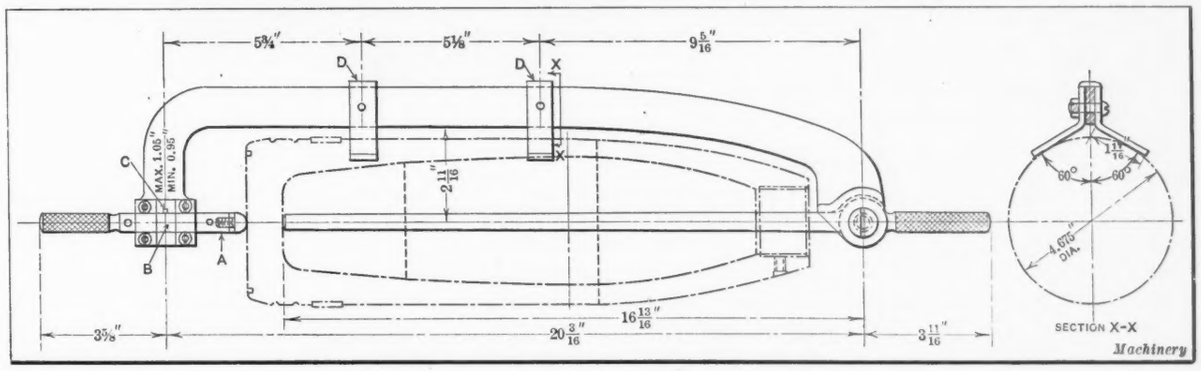


Fig. 18. Gage for measuring the Thickness of the Base

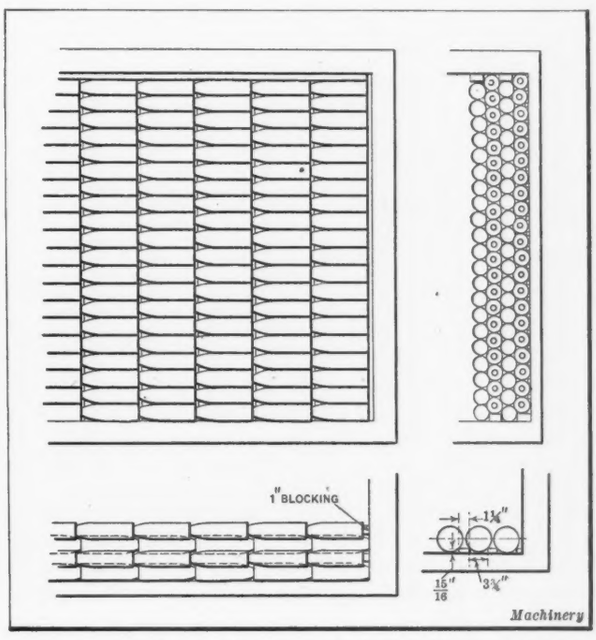
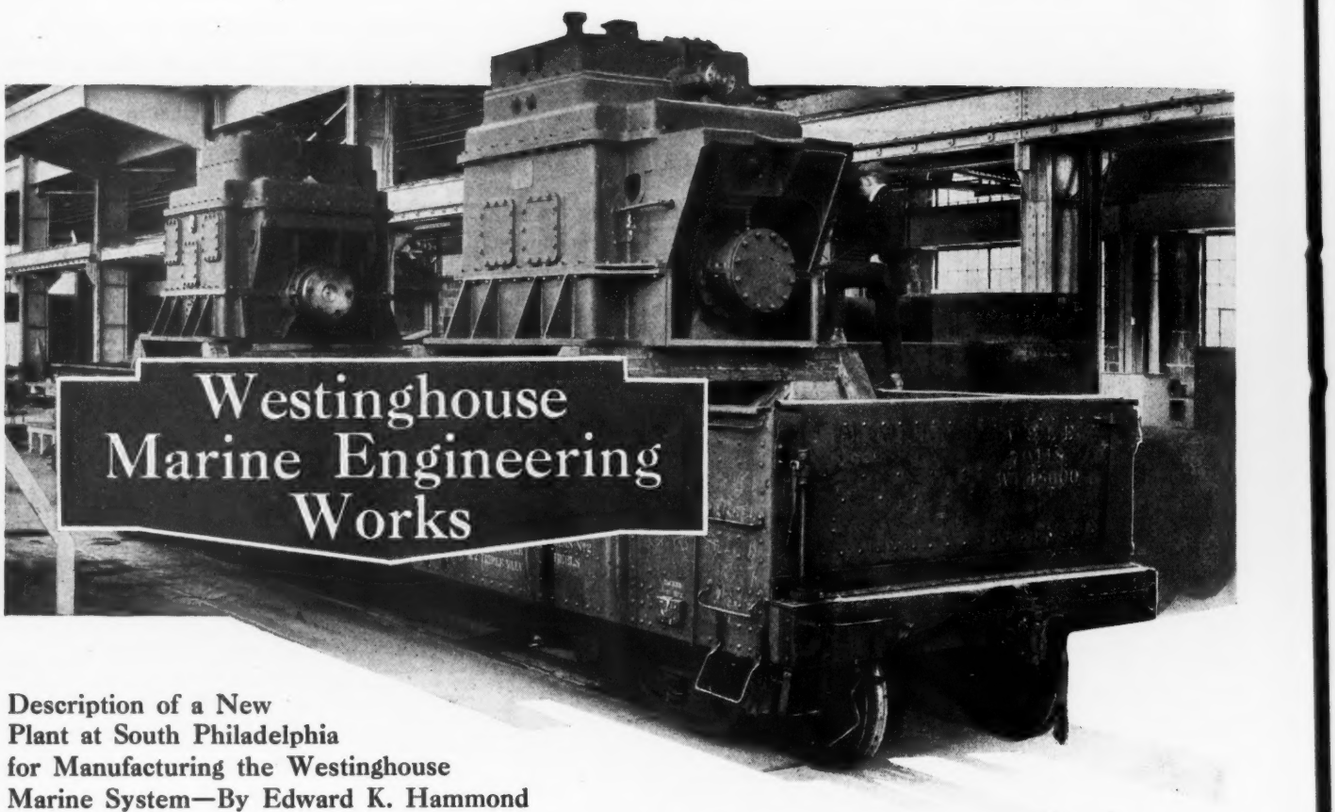


Fig. 19. Method of packing the Shells in Box Cars for shipping



Westinghouse Marine Engineering Works

Description of a New Plant at South Philadelphia for Manufacturing the Westinghouse Marine System—By Edward K. Hammond

AT the plant of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., in which 30,000 men are employed, there is no possibility of making further extensions of manufacturing facilities because none of the property adjoining the plant is available for such a purpose. This condition made it desirable to provide increased capacity to handle the steadily growing business of the company, and with this idea in view a decision was reached some time ago to obtain a new factory site on which a plant could be built for the manufacture of the Westinghouse marine system that will be described in a later section of this article. Those who are familiar with the company's affairs, know that this department of the business was formerly handled at East Pittsburg in the plant of a subsidiary known as the Westinghouse Machine Co. With the provision of a new plant in which to conduct this marine engineering work, the existing facilities of the Westinghouse Machine Co. would then be made available for the extension of facilities for manufacturing the regular line of Westinghouse electrical products.

Plant at South Philadelphia not a War Industry

Since the receipt of orders by American manufacturers for vast quantities of munitions required by the belligerent powers of Europe, there have been erected in this country a large number of plants for handling such work, and in many cases it has been the intention to construct buildings adapted for temporary occupancy, but with no intention of permanently continuing manufacturing operations in them. In order to guard against the possibility of any readers forming an erroneous idea concerning the plans of the Westinghouse Electric & Mfg. Co. in constructing its new plant, it will be wise to outline briefly the steps which led to this industrial development. Attention has already been called to the fact that it was the lack of space at East Pittsburg which caused the company to consider transferring its marine engineering business to a new location, and after this decision was reached, H. T. Herr, vice-president of the company, was requested to find a factory site which would be adapted to the peculiar requirements of this industry. It was decided that the plant should be near the Atlantic Seaboard, and also have facilities for making shipments by rail; and with these points in mind, Mr. Herr was eventually successful in locating a tract of land in South Philadelphia, situated on the Pennsylvania shore of the Delaware River, and adjacent to the lines of both the Pennsylvania Railroad and the Philadelphia & Reading Railway.

Advantages of the Plant's Location

For the purpose of engaging in this particular branch of the marine engineering industry, the situation of the new Westinghouse plant is peculiarly advantageous, as it is on the Delaware River in close proximity to several important shipbuilding yards, among which may be mentioned the New York Ship Building Co.'s plant at Camden, N. J., the Hog Island plant of the Emergency Fleet Corporation, and the yards of the Chester Shipbuilding Co., and the Sun Shipbuilding Co. at Chester,

Fig. 1. General View of the Pattern Shop and Pattern Storage Building. This was the First Structure to be completed

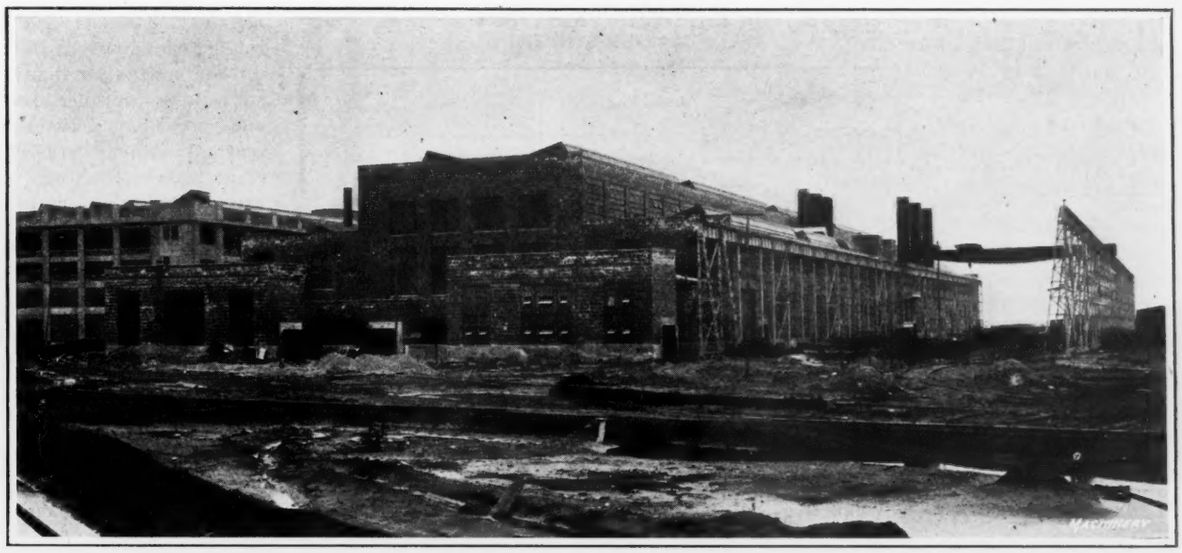


Fig. 2. The Foundry Building, shown in this Illustration, was the Second One completed. Attention is called to the Crane provided with an Electromagnet Attachment for lifting Pig Iron and Scrap in the Yard

Pa. Assuming that the application of steam turbines as a means of propulsion is to find an extensive application in our mercantile marine, the Westinghouse plant is advantageously located to cooperate with the shipbuilders to the best advantage.

A tract of 500 acres of land was purchased during the latter part of 1916, and on this site construction of the factory buildings was started in April, 1917. It is probable that the erection of the plant might have been delayed by the scarcity of building materials and labor at this time, had it not been for the unusual demand for propulsion equipment for ships resulting from the construction programs of the Emergency Fleet Corporation and of the Navy Department. As it was, the Westinghouse company received valuable cooperation from the Government, and was able to push its plans with such dispatch, that the last of the buildings was completed on November 15, 1917. This does not mean, however, that other work had been delayed in the meantime. For instance, the pattern shop and pattern storage building was the first completed, and this building was immediately equipped so that work could be started while construction operations were still proceeding on other buildings. Attention was next turned to the foundry building, and as soon as this structure was finished, equipment was available for installation so that here again actual operations could begin without delay. Next came the forge shop, followed by the two machine shops, and finally the erecting shop. A little study will make it apparent that by following this construction program and by having equipment available for installation as soon as the respective buildings were completed, the company was able to have patterns available for use in the foundry, castings and forgings for the machine shops, and finally, finished parts completed for assembly, by the time the construction and equipment of the erecting shop was completed. The establishment of new records in the erection of manufacturing plants is becoming almost commonplace at present, but the construction and equipment in seven months of seven buildings having thirty-five acres of floor space, is certainly a noteworthy achievement, even under present conditions.

It was largely owing to the able way in which the erection of the plant was handled, that the company was able to make the highly creditable showing of the finished product. The first Westinghouse marine system was completed ready for shipment on June 23, 1918, although the first actual shipment of manufactured material was made to the Submarine Boat Corporation on March 25, less than one year after the construction of the plant was started. It is the belief of the

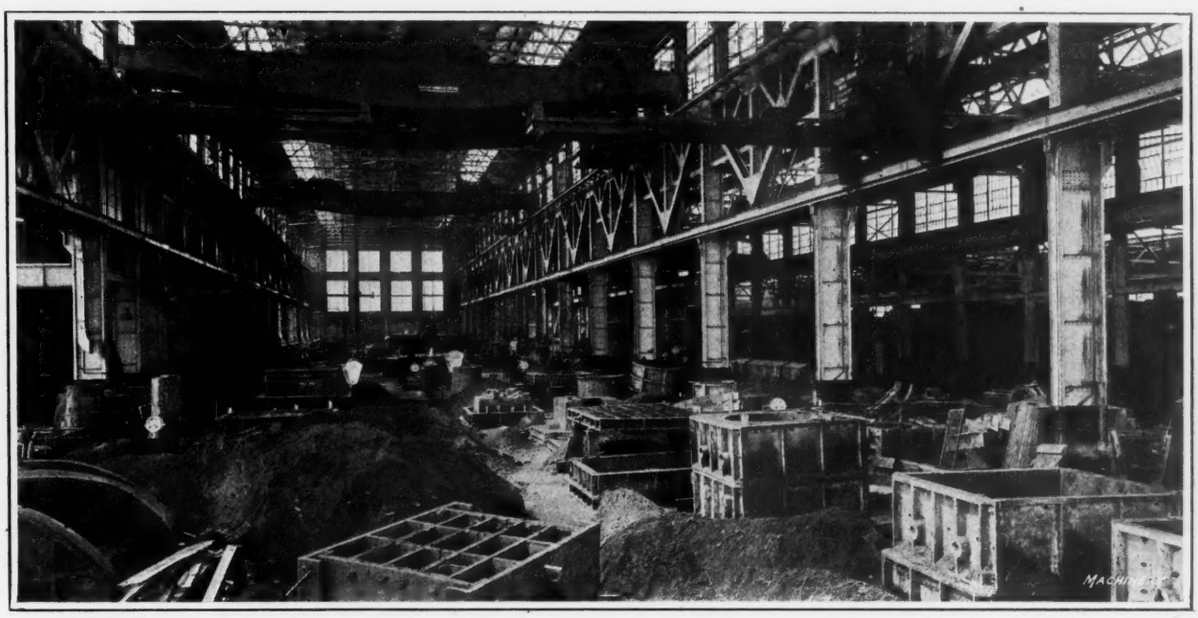


Fig. 3. General Interior View of the Foundry. This Illustration gives a Good Idea of the Excellent Equipment of Overhead Traveling Cranes and Wall-type Cranes, which are provided to facilitate handling the Work

Westinghouse management that the output will increase steadily until the plant's rated capacity of one complete turbine equipment of average size will be finished every day.

Development of the Westinghouse Marine System

In 1909, the late George Westinghouse began work upon the development of a reduction gear suitable for use in obtaining the necessary speed ratio between a steam turbine spindle and the propeller shaft of a ship. This work was carried on in cooperation with the late Rear Admiral George W. Melville, formerly chief engineer of the United States Navy, and John A. MacAlpine, a marine engineer of international reputation. This gear is carried by a floating frame, which is one of the essential features of the design that makes it possible to transmit high powers at high speed. The practicability of this system for employing turbines in driving ships has been fully demonstrated by the service obtained from Westinghouse marine systems built at the Westinghouse Machine Works in East Pittsburg.

Steam turbines have many noteworthy advantages over reciprocating engines for use in driving the propellers of a ship, one of the most important of these being the much more compact form of the turbine, which enables a greater proportion of the space in the vessel to be available for carrying cargo; another important point is the higher mechanical efficiency which enables the turbine-driven ship to make a voyage with a smaller consumption of fuel, and also without the necessity of devoting such a large percentage of the ship's capacity to carrying fuel required for the voyage. These advantages are so pronounced that the application of turbines for ship propulsion is steadily increasing, and this statement applies to both cargo and passenger ships as well as to different types of naval vessels.

An idea of the different types of merchant ships in which Westinghouse marine systems built at the South Philadelphia plant have been installed will be gathered by reference to the accompanying table; and in this connection it will be interesting to note that there are now 350 complete marine propulsion equipments on order or under construction at the Westinghouse plant. These have a total capacity of 1,500,000 horsepower, and represent enough work to keep the factory operating at full capacity until the end of 1919. These equipments include steam turbines, reduction gears, condensers, condenser pumps, small turbine-driven generator equipments for lighting, stern tubes, propeller shafts, and propeller shaft bearings. In other words, the plant makes practically the entire equipment required between the boilers and the propellers of the ship. The largest of these equipments is the 12,500 horsepower unit, and none of the equipments on order is less than 1500 shaft horsepower.

SOME OF THE SHIPS EQUIPPED WITH WESTINGHOUSE MARINE SYSTEMS

Name of Ship	Where Built	Type of Ship	Shaft Horsepower
Malmanger	Chester, Pa.	Oil Tanker	2900
Golaa	Chester, Pa.	Oil Tanker	2900
Hisko	Chester, Pa.	Oil Tanker	2900
Avondale	Chester, Pa.	Oil Tanker	2900
Sudbury	Chester, Pa.	Freighter	2300
Overbrook	Chester, Pa.	Oil Tanker	2900
Coronado	Oakland, Cal.	Freighter	2400
Yosemite	Oakland, Cal.	Freighter	2400
Yellowstone	Oakland, Cal.	Freighter	2400
Oakland	Oakland, Cal.	Freighter	2900
Westerly	Seattle, Wash.	Freighter	2500
Westwood	Seattle, Wash.	Freighter	2500
West Eagle	Seattle, Wash.	Freighter	2500
Maui	San Francisco, Cal.	Passenger	12500
West Ford	Seattle, Wash.	Freighter	2750
Accomac	Los Angeles, Cal.	Freighter	3000
Polar Sea	Baltimore, Md.	Freighter	1800
Wakulla	Los Angeles, Cal.	Freighter	3000
Montrolite	Seattle, Wash.	Tanker	2500
Wampum	Los Angeles, Cal.	Freighter	3000
Wassiac	Los Angeles, Cal.	Freighter	3000
West Galoc	Los Angeles, Cal.	Freighter	3000
Phoenix	Chester, Pa.	Tanker	2900

Machinery

Sizes and Facilities of the Present Factory Buildings

In order to provide for manufacturing the Westinghouse marine system in South Philadelphia, the present plant comprises a pattern shop and pattern storage building 132 by 396 feet in size, a foundry building 186 by 602 feet which has a capacity for 4,000,000 pounds of castings a month, a forge shop 76 by 389 feet, two machine shops each measuring 129 by 741 feet, and an erecting shop measuring 129 by 600 feet. In addition, there is a power house 87 by 175 feet in size. All of the buildings are of absolutely fireproof construction; they are built of steel and reinforced concrete, with terra cotta tile walls and steel window sashes. The roofs are of concrete construction. In general features, the equipment of these buildings is in accordance with standard practice in providing for the various classes of manufacturing operations which are to be carried on in them. It is important to note, however, that all of the equipment is new and that particular care has been taken to select all machinery and auxiliary apparatus to provide for handling the work with the greatest possible facility. The buildings have a combined floor space of about 35 acres and give employment to 5000 operatives. With this equipment the plant has a capacity for constructing approximately 75,000 horsepower of marine apparatus per month, which is equivalent to the propulsion equipment for fifteen steam-driven vessels of average size.

From the preceding description the readers will have obtained a fairly comprehensive idea of the new plant at South Philadelphia for manufacturing the Westinghouse marine system. According to present plans, this part of the plant is now completed; but it must not be thought that the development at South Philadelphia has by any means reached its final form. On the five hundred acre tract of land it is also proposed to construct factory buildings for use in the manufacture of electrical products. These additions

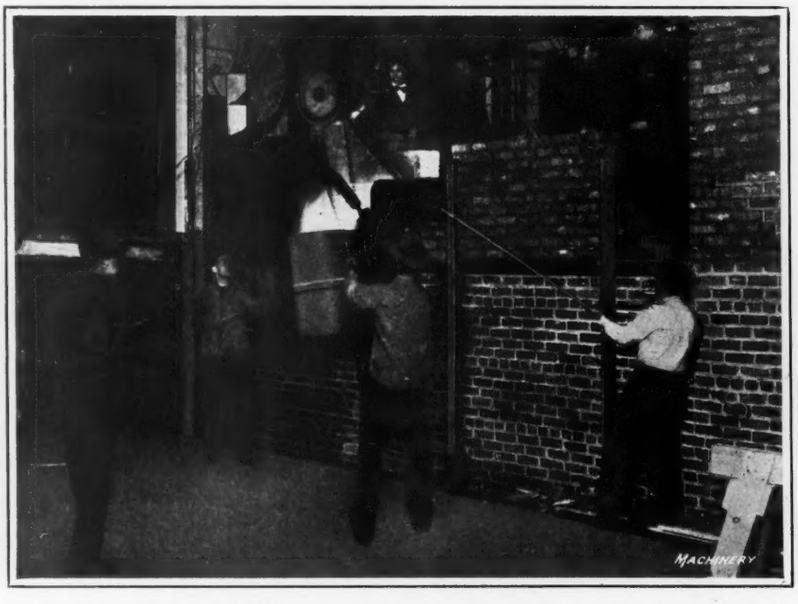


Fig. 4. Tapping the First Molten Iron from the Foundry Cupola. This was the First Actual Manufacturing Operation in the New Plant

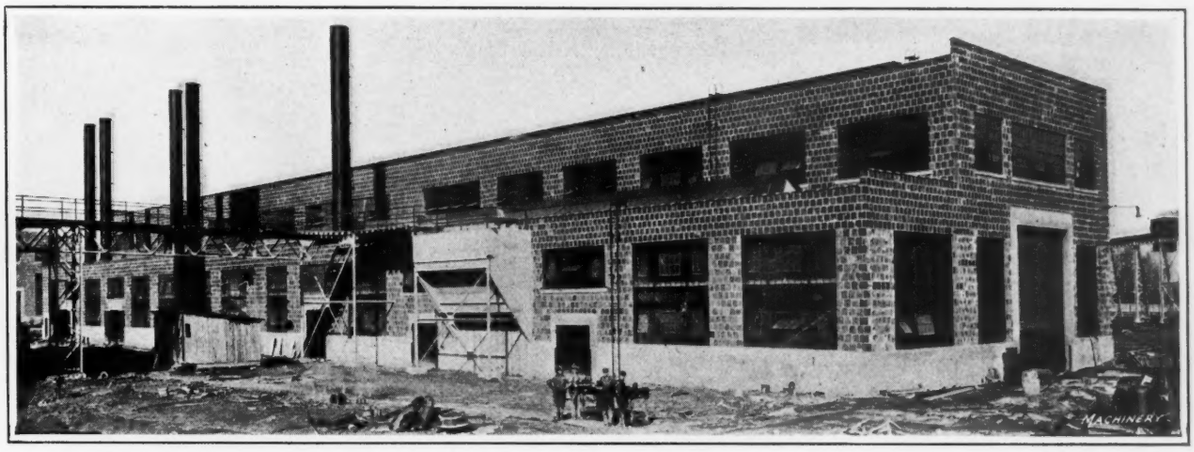


Fig. 5. Exterior View of the Forge Shop which was the Third Building erected. This Shop is fully equipped with Hydraulic Forging Presses, Steam Hammers, Heating Furnaces, Traveling Cranes, etc.

will make the size of the completed plant approximately four times that of the marine engineering section which has already been completed.

Ideal Facilities Provided for Conducting Manufacturing Operations

Where it is possible to lay out a complete plant on paper, and to provide an ideal location for the various departments in relation to each other, it naturally follows that much better results can be obtained than where a plant grows slowly, making it necessary to provide extra facilities at those points where room is available for expansion. One sees the truth of this principle after going over the new Westinghouse works and seeing how each of the buildings of the plant, and the various departments in each building, have been related so that the work of transferring materials and product has been simplified to a point where the highest degree of efficiency is attainable. Every machine tool in the plant is equipped with individual electric motor drive, which gives the double advantage of high transmission efficiency and freedom from overhead belts or shafting. Another important advantage has been secured through the purchase of the latest and best types of machine tools and other mechanical equipment for the plant, so that everything is of the most modern form and therefore capable of giving the highest degree of manufacturing efficiency instead of forcing those men who are responsible for production to do the best they can with machines that are out-of-date, but which they are unable to replace with modern tools because of a false idea of economy which is held by the management. There are many factories throughout the country which are laboring under severe handicaps of this kind because of the unwillingness of directors to discard obsolete equipment.

Fig. 6. There are Two Machine Shops at the New Westinghouse Plant, which have All the Most Modern Types of Equipment. These Two Buildings were Fourth and Fifth in Order of Erection

Providing for the Welfare of Employes

Probably there is no one point in industrial management which has undergone a more noticeable change during the past fifteen or twenty years than the attitude of employers toward their force of workers. Years ago there were many

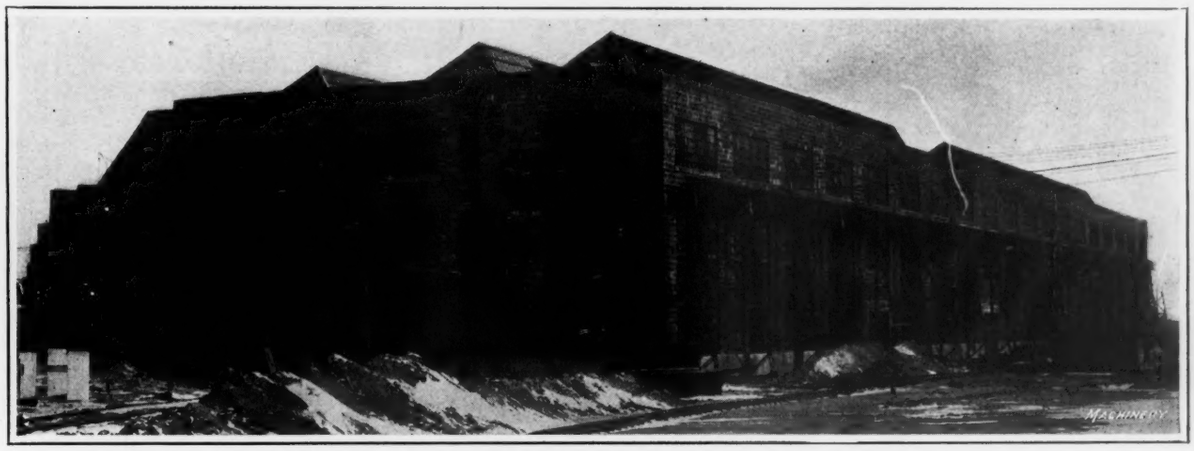


Fig. 7. Exterior View of the Erecting Shop. This Building was the Last One to be completed. It is constructed across the Ends of the Machine Shops, so that Finished Parts may be transferred with a Minimum Loss of Time

Fig. 8. General Interior View of the No. 2 Machine Shop. Attention is called to the Standard Gage Railroad Track and Overhead Cranes for carrying Heavy Work, and to the Liberal Amount of Window Space which assures an Abundance of Light

plants in which the policy of the management was uniformly antagonistic to labor and where little attention was paid to the provision of satisfactory working conditions. This is diametrically opposed to the present attitude of progressive manufacturers who realize that a force of trained workers is one of their most valuable assets, and who therefore are both willing and anxious to provide satisfactory working conditions for the men who are engaged in maintaining the quantity and quality of the work produced in the shops. This progressive attitude in regard to labor is exemplified in the new Westinghouse plant where all of the most modern facilities are provided to make working conditions pleasant and to assure the health and safety of the workers as far as possible. In each of the buildings, ducts are provided through which hot air is delivered for heating the shops in the winter, and cool air for cooling the shops in the summer. Each building is also provided with an ample number of windows which are so situated that all portions of the shops are thoroughly lighted. Past generations of manufacturers would have regarded such provisions as entirely unnecessary, but men who have carefully studied production figures under modern methods of conducting manufacturing operations realize that the maintenance of proper working temperatures and the provision of an ample supply of light are vital factors in enabling each worker to maintain the required rate of production and the desired standard of perfection in the product during the entire working day.

Employing and Training the Working Organization

Before manufacturing operations could be started in the new plant it was, of course, necessary to hire and train a force of men for handling the various parts of work which have to be carried on in this industry. The nucleus of this organization came from the Westinghouse Machine Works in East Pittsburg, but the number of workers obtainable from this source was entirely inadequate. It was therefore supplemented by hiring as many skilled mechanics as possible, and also many men of little mechanical experience,

Fig. 9. General Interior View of the Forge Shop. Some of the Heating Furnaces are shown at the Left and the Hydraulic Forging Press in the Background. Several of the Forging Hammers and One Traveling Crane are also shown

Fig. 10. Here is a View down One Street of the Model Village that is being built for the Benefit of Westinghouse Employes. Men engaged in the Works are privileged to either buy or rent these Houses on Advantageous Terms

all of whom had to be carefully instructed in the details of this highly specialized form of industry. This work was started a little while before the shops were ready to receive the workers, and today the company has a total force of about 3000 men on its payrolls. This number, however, represents slightly less than 50 per cent of the working force that will eventually be employed in the section of the new Westinghouse plant that has already been completed.

The work of training employes for service in the marine engineering plant is not yet thoroughly under way, but there are two methods of training that will be employed, and from which very satisfactory results will doubtless be obtained. One of these is to take boys for a four-year apprentice course, under the terms of which they will receive 20, 24, 28, and 32 cents an hour, respectively, for the first, second, third, and fourth years of their period of indenture. The company is prepared to offer this course of training to 600 boys. A somewhat similar plan will be adopted for training men required for some of the more important positions in the factory. This course of training will be open to graduates of recognized technical schools and will cover a period of two years. Men who come in under the terms of this agreement will receive 35, 40, 45, and 50 cents an hour respectively, for the first, second, third, and fourth six-month periods of their two-year training course. After receiving a thorough practical training of this kind, men with a technical education will be prepared to undertake the duties of many responsible positions that will be open to them. By this arrangement, both the company and the men are benefited.

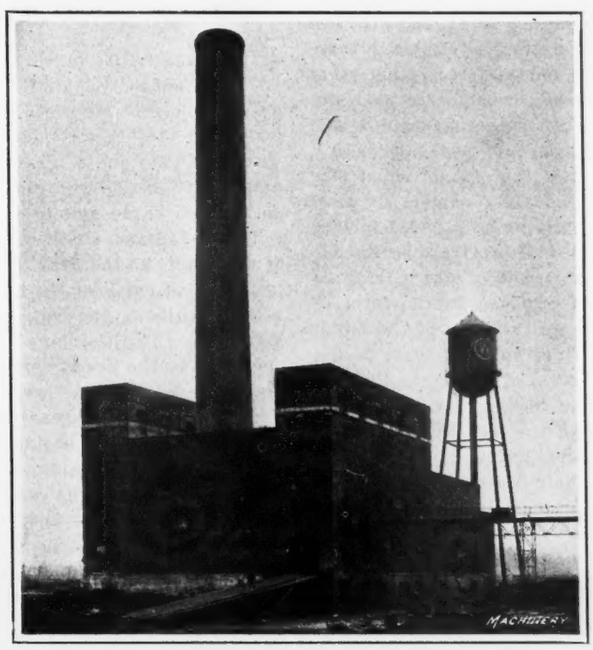


Fig. 11. General View of the Power Plant

How the Housing Problem is being Handled

The Westinghouse plant at South Philadelphia is located approximately eight miles from the City Hall, and at a distance of four miles from the city of Chester. This location made it desirable to provide housing facilities for those employes who wish to live near the plant, as there was an insufficient number of houses in the immediate vicinity. This method has been approached in two ways, both of which are working out in a highly satisfactory manner. The problem naturally divides itself into furnishing living facilities for employes of the company who have no families, and houses for those men who wish to make a home for their wives and children in the immediate vicinity of the works. For the former class, the Essington Club has been constructed, in which the men are able to obtain a bedroom, while meals are obtainable in a general dining hall. This bids fair to solve one part of the problem in a highly satisfactory manner. The question of furnishing homes for married men has been worked out in an equally satisfactory way by the construction of a large number of modern dwellings, which employes of the company will either be able to rent or purchase.

These houses were designed by architects who carefully considered the questions of providing satisfactory living facilities for the respective inhabitants, and of developing a community of highly artistic and pleasing appearance. Some houses are built of brick, while others are finished outside with stucco. This work of construction is now approaching completion, and as will be seen from the views presented in connection with this article, the community is one which

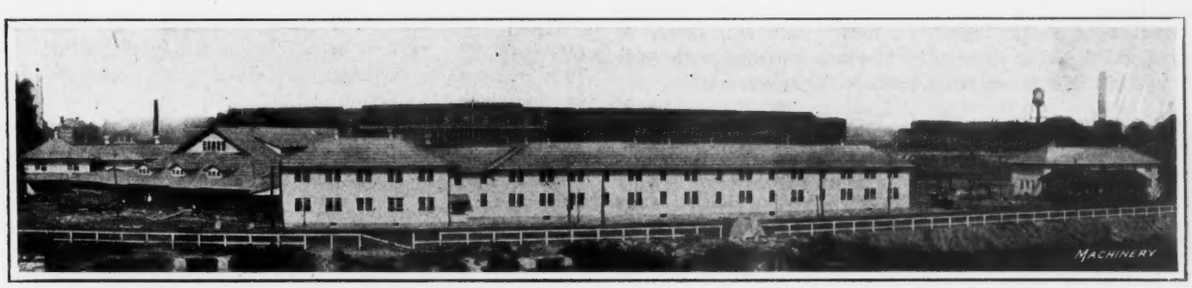


Fig. 12. General View of the Essington Club provided for the Convenience of Unmarried Westinghouse Employes. The Central Section is devoted to Individual Bedrooms, and the Porch at the Left is reserved for the Occupants of these Rooms. At the Left-hand Side, there will be seen the Roof of a Building devoted to what is known as the "Dormitories"; that is, Large Rooms furnished with 125 Cots in Each Room. The Small Building at the Right is furnished with Individual Bedrooms for the Use of Women employed in the Club

would compare favorably with many of the best suburban sections of leading American cities occupied by the middle classes. This section of the city will be known as South Philadelphia, and a separate corporation, known as the South Philadelphia Co., has been organized to handle the renting and real estate transactions with employes in order to avoid any feeling on their part that their relations with the Westinghouse Electric & Mfg. Co. will be affected through any commitments which they enter into in regard to the renting or purchase of houses which have been provided near the plant.

It is planned to build 315 of these houses, and 200 are now in course of construction. Each house will be provided with steam heat, electric light, and all other modern conveniences. The houses will range in sizes from five to eight rooms. The South Philadelphia Co. has acquired a tract of 400 acres of land on which this model village is being constructed, and arrangements have been made with the Government to provide a new post office which will be known as the South Philadelphia Station.

The Essington Club has a total capacity for housing 549 persons. There are 250 private bedrooms for men employed in the plant, and this section of the club has its own dining room. The building is two stories high, with 125 bedrooms on each floor. On each floor there is also a wash room equipped with two bath tubs, ten shower baths, and nineteen wash bowls; running hot and cold water is available in these wash rooms at all times. A well equipped recreation room is also provided on each floor, in which there are pool and billiard tables, arm chairs, writing tables, magazines, etc. For a private bedroom and meals, the men pay only $9.50 a week. There is a second section of the club of equal size and with provision for housing the same number of men, namely 250. This portion of the building is intended for the use of laborers and it is not provided with private bedrooms; instead, there are two dormitories in each of which 125 beds are placed. Similar facilities are provided in the form of wash rooms, recreation rooms, etc. in this part of the building. In the dormitory section of the building there is the so-called "mess hall" or cafeteria form of service in the dining hall; but the equipment of the room is similar to that of the dining hall in the section of the building where the private bedrooms are situated. Men living in this section of the club pay $7.50 a week for their board and room.

In addition to the provision of living accommodations for 500 workmen, there is a separate wing in which bedrooms are provided for thirty women who are employed in domestic work about the club. In this wing, each bedroom is furnished with hot and cold running water and electric light. Over the kitchen, sleeping quarters are provided for fifteen men employed in this department, and the final space in the building is taken by four bedrooms with private baths, which are reserved for the use of the manager of the club and three of his chief assistants. The provision of a well equipped kitchen is an important feature in any organization that is arranged to provide living facilities for working men, and this point has received careful attention in planning for the Essington Club. All of the most modern types of refrigerators, ovens, and the various forms of auxiliary culinary apparatus are provided for the use of the cooks, so that there is no reason for their not being able to furnish the men with wholesome and appetizing food. This will surely be an important factor in keeping the men satisfied with their employment and in enabling them to work efficiently.

* * *

An association known as the British Gage Manufacturers Association, Ltd., has been formed in Great Britain with the object of promoting and protecting the British gage manufacturing industry. The association has offices at 44 Caxton House, Westminster, London, where its secretary is permanently located. The British Government is said to have encouraged the formation of the association, and it is being aided by the Ministry of Reconstruction.

OPPORTUNITY FOR FOREIGN TRADE SHOULD BE GRASPED NOW

By OSCAR ERICSSON, Manager in the United States of Nielsen & Winther, Ltd., Copenhagen, Denmark

In speaking to a manufacturer of machine tools, recently, the writer asked him about his foreign agencies and was told that he had established agencies in England and France, but had as yet taken no steps with regard to the Scandinavian countries. His attention was called to the fact that England and France shortly would be keen competitors of his and that the agencies in those countries might, in the long run, prove of less importance than an agency in the Scandinavian countries where there was a market for machine tools that could be entered without encountering the same amount of competition. This manufacturer recognized the peculiarity of the situation of having good representatives in countries that would be his keenest competitors, and of not being represented at all in countries that were likely to be good customers.

There are a number of similar instances, and it would seem appropriate to call the attention of American machine tool builders to this fact. Germany, in her effort to pay the great indemnity that will be imposed upon her, will be very active in foreign trade, especially in the countries that were neutral during the war, and the only way in which American machine tool builders can successfully meet this German competition will be by becoming active *now*, before Germany is in a position to manufacture again. The writer's experience and connection with the machine tool trade in Scandinavia makes him confident that the German competition there can be met successfully by American machine tool manufacturers if they will make an effort immediately to obtain this trade and to impress upon the Government of the United States the necessity for permitting the shipping of machinery to the Scandinavian countries, where a market is already at hand for the machines that can be shipped.

No machinery has been shipped to these countries for a long time. The Germans know this and are ready to sell machines in the Scandinavian countries as soon as they are organized on a peace basis. The only way in which the United States can become the leading country in the world in the machine tool business is by paying attention to the European market in a somewhat more vigorous manner than has heretofore been the case. American machine tool manufacturers ought to inquire into the present opportunity for the sale of machine tools in Scandinavia, and should then insist that the Government release sufficient shipping space to carry their machines to Scandinavian ports.

* * *

SAMPLE BOARD FOR DIE WORK

It is customary in some of the leading shops which specialize on pressed, punched, and drawn metal work to provide sample boards on which are hung specimens of the more interesting types of work produced. On pieces where several operations are required, there is a sample showing the result of each operation. As referred to by C. W. Starker, in an article in *Industrial Management*, these samples may be used as models, and parts made from worn dies may be checked up with the first specimen from time to time. The samples are also an excellent educational medium for toolmakers and designers, as well as for the engineer and draftsman. In a few minutes, by visual demonstration, a better idea may be obtained of the action of the material in the dies, of possible depth of draws, and of the influence of flanges or corners on drawn or bent parts than could be gained in any other manner. The exhibition of parts that have caused trouble, either in the making of the tools or in the production of the article, may serve as a warning against future difficulties on similar work. Such samples then become instructive—more so, even, than the good examples. If these parts were not kept for record, more than likely the same difficulties and mistakes would be indefinitely perpetuated.

LETTERS ON PRACTICAL SUBJECTS

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WORK-BENCH OF STEEL SHELVING

In the construction of lathes, it is the practice of the Lodge & Shipley Machine Tool Co. to first build the units such as taper attachments, aprons, carriage, etc., and then assemble them. The storage bins containing the parts from which the units are assembled, were formerly located at one

Fig. 1. Work-bench constructed of Standard Shelving with Provision for storing Parts

side of the room, and it was necessary for the workmen to leave their benches to get new supply parts to assemble each unit. In order to do away with this unnecessary walking, a new type of work-bench was designed.

This bench was made up from standard shelving of a type having great strength and rigidity inherent in its design, which made it possible to construct this bench from the shelving without any additional reinforcement. As the shelving is of the adjustable type, it is possible to change the location of the horizontal and vertical dividers so that the compartments may be made of the size best suited to meet the requirements of the workmen. All the parts used are of stock pattern and the bench is virtually two sections of storage shelving placed back to back with a one-piece sheet-steel top, as shown in the illustrations. This construction gives the workman an abundance of compartments in which to place the parts from which he assembles the units. Thus time is saved in making the assemblies, and the workmen do not interfere with each other's movements, since three

Fig. 2. Work-bench showing Wooden Pad bolted to Top for such Work as Scraping

men work on each side of the big double bench, and their work can be done entirely without leaving their benches.

In the case of the Lodge & Shipley Machine Tool Co., most of the work to be done was such that the full steel top was preferred. For such work as scraping, etc., provision was made for bolting wooden pads about 2 by 3 feet to the top of the bench as shown in Fig. 2. The benches, however, could have been made with full wooden tops or combination half wood and half steel.

Aurora, Ill. D. M. PERRILL

NEW GAGING IDEA

The gaging of concentricity or alignment where more than one tolerance on the work to be gaged has to be taken into consideration is usually a difficult proposition. Take, for instance, the piece shown in Fig. 1. Here the opening which has a tolerance of 0.020 inch, or plus or minus 0.010 inch, must be gaged for its relation to the center line X–X of the one-inch hole; the sides must be parallel with this center line and have a tolerance in either direction of 0.005 inch. If there were no tolerance, in other words if the opening were held exact, it would be an easy matter to line up

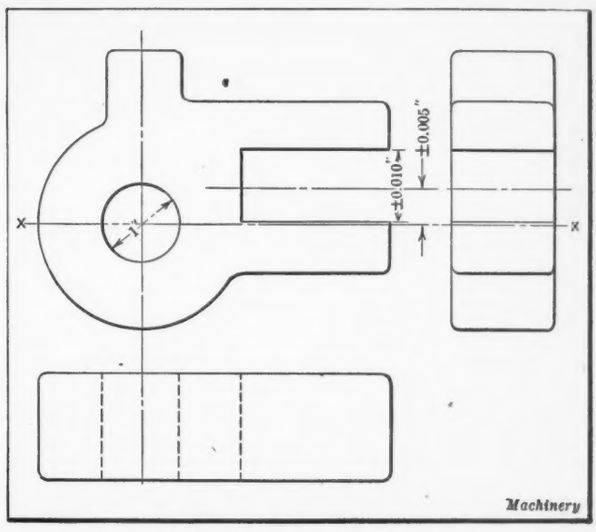


Fig. 1. Piece of Work that is Difficult to Gage

against one side of the opening and indicate the hole. When a tolerance is given, it is necessary, as a rule, to gage the opening, so as to get its actual width in thousandths of an inch, and then line up one side at a time, indicate the hole from each side, and by calculation find the exact location. This method is all right for a few pieces, but when thousands must be made, more rapid means have to be devised.

A gage that will take into consideration the tolerance on the width and give instantly the exact location of the center line of the opening and its relation to the hole is shown in Fig. 2. This consists of a hardened and ground plug *A* that is round on one end and square on the other. Two opposite corners *H* have been cut off so that the distance across them is less than the minimum width of the opening in the work, while the other two corners *K* are left on and the distance across them is a few thousandths of an inch greater than the maximum width of the opening to be gaged. The round end of the plug is mounted in a hardened and ground slide *B*, which is a free sliding fit in the base *C*. This slide is exactly at right angles to the center line of the work to be gaged when the work is placed over the

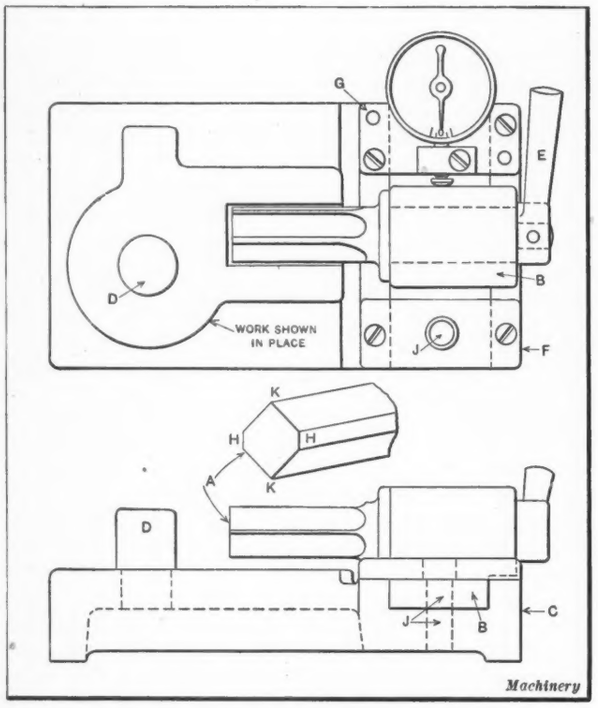


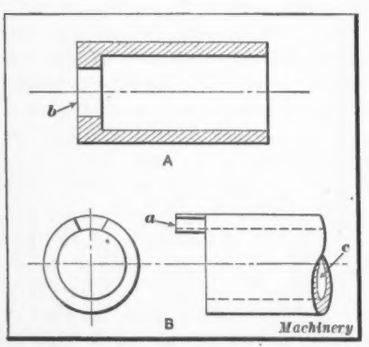
Fig. 2. Gage for Work having More than One Tolerance

locating plug *D*. To use this gage, the work is first placed over the plug *D;* then the plug *A* is turned by means of the handle *E* until the two edges *K* engage with the sides of the work. As pressure is exerted, this plug automatically brings the work and the slide *B* into alignment with each other. The slide *B* is held in place on the base by means of two hardened and ground strips *F* and *G*. On the strip *G* is mounted a dial indicator, the point of which is always in contact with a part of the slide *B*. The location of the slide may be read from the dial. For setting the dial gage correctly and for checking purposes, holes *J* in the slide *B* and the base *C* are in exact alignment when the slide is in the correct position for getting the indicator at zero. To set or check the indicator, it is only necessary to insert a standard plug gage of the correct size in the holes in order to bring them into alignment. So far as the author knows, this use of a square plug mounted on a slide for gaging is a new idea and one that can be applied to a wide range of work.

New York City DONALD A. BAKER

LOCATING CENTERS WITH SPECIAL BUSHING

When locating centers for holes by the button method on the milling machine, instead of using a bushing such as shown in the illustration at *A*, with a hole at one end to fit the arbor in the spindle of the machine and a hole *b* to fit the button at the opposite end, a bushing similar to the one shown at *B* will be found more convenient and easier to work with. The hole *c* of this bushing is a sliding fit on the arbor of the milling machine, and the inside surface of lug *a* should have the same radius as that of the button attached to the work. The operator, in lining up the work, adjusts the table of the milling machine until the button will clear the inner surface of the lug freely at all points as the bushing revolves. In this position the work is in alignment, and ready to be bored. One advantage of this type of bushing is that the button, being more exposed than the type of bushing shown at *a*, enables the operator to see better in centering his work.



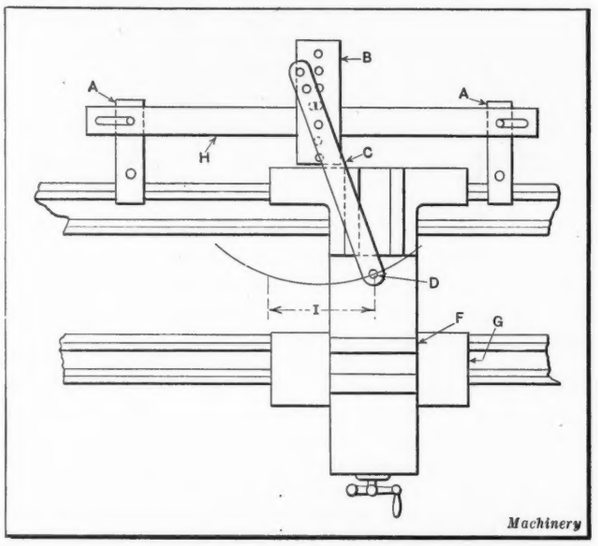
Special Bushing for locating Centers by Button Method

Dorchester, Mass. H. E. BRIDGES

PULLEY-CROWNING ATTACHMENT FOR THE ENGINE LATHE

While there are numerous devices and machines on the market for turning and crowning pulleys, convenient methods for performing the work on an engine lathe are of value in many cases. The old conventional way of crowning is by finishing half the pulley with the tailstock set over, and then, by reversing the mandrel, the remaining part is finished. The result is a crown consisting of a high section in the center caused by the angular cuts. The attachment shown in the accompanying illustration has been successfully used for turning pulley faces.

Referring to the illustration, the bracket *B* is supported by bar *H* and is capable of sliding thereon to obtain suitable adjustment. The bar *H* is held by the two brackets *A*, attached to the vees of the lathe. Lever *C*, which swings on bracket *B*, describing an arc, controls the direction of the cut. The screw at *D* holds lever *C* to the cross-slide *F*. *G* is the carriage. *I* represents the face of the pulley, which in this case, may be assumed to be 4 inches. Lever *C* is first set to a radius of 12 inches by means of the series of holes in bracket *B* and lever *C*. The pulley mounted on a mandrel is placed between centers, and bracket *B*, lever *C* and the center of the pulley are set parallel, bracket *B* being clamped securely to bar *H*. Starting a cut from right to left, the cross-feed screw is released from the nut so that the slide *F* is free to move as determined by lever *C*. After setting the machine, it is unnecessary to change anything except, of course, to adjust the tool by means of the compound rest or slide and to mount the pulleys on the mandrel to the same distance. The following settings for the lever *C* have been found to give satisfactory results, although any radius may be used as determined by the height of the crown that is wanted. For crowning a 2-inch face, 9 inches radius; for a 4-inch face, 12 inches radius; and for a 6-inch face, 15 inches radius.



Attachment for crowning Pulleys on the Lathe

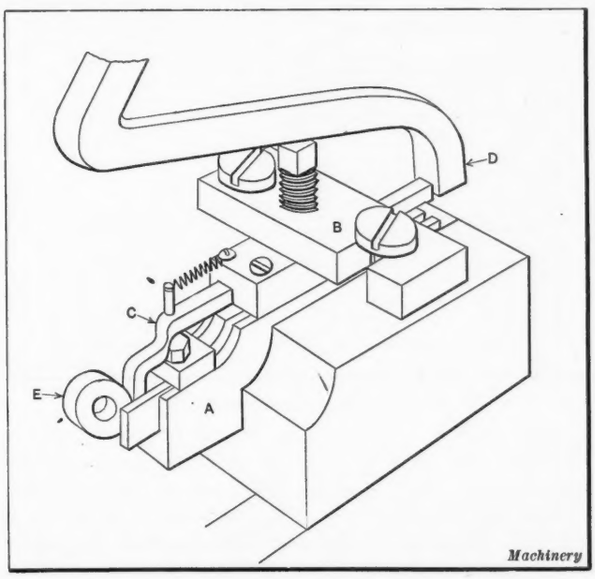
St. Louis, Mo. THOMAS KRAUSKA

STRIPPER FOR CUTTING-OFF TOOL

The regular cutting-off slide on the Acme screw machine is recessed to allow the tool-holder to drop in place and be nearly flush with the top of the slide. When multiple cut-

ting-off operations are performed, a special slide is used which carries the tools and the stripping or clearing device for positively ejecting any parts that might be left between the blades of the cutting-off tool. The accompanying illustration shows a stripper that was used on an automatic screw machine when two cutting-off blades only were required, and which could be dropped into the recess and tightened, just as in the case of a single tool, without using a special slide.

The shank *A* is made of soft steel and casehardened. Slots for the two blades are milled and as the outside dimension of the blades is less than the width of the recess in the slide, the blades are supported clear to the end of the shank. A single ¼-inch diameter hexagon cap-screw and strap are used to fasten both blades. Screwed to the top of the shank is a block *B* having a slot in which the stripping member *C* slides freely. The stripper is a piece of square cold-drawn steel and is bent at right angles at the inner end as shown in the illustration, so as to travel between the blades. A spring keeps the stripper normally back, but when the slide is returned by the cam, the projecting straight end contacts with a stationary piece *D* and forces the part *E* which has just been cut off, out from between the blades. This stationary piece is most conveniently formed as shown in the illustration, and is suspended from the overhead slide which is not in use.



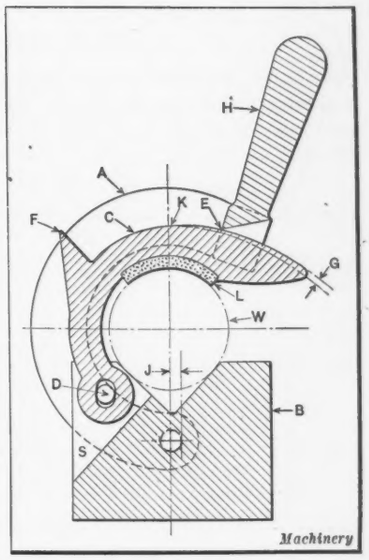
Double Cutting-off Tool Stripper for the Acme Screw Machine

Such a stripper is positive in action and there are no parts to become loose or to need readjusting after the tools have been sharpened. In cases where the conventional style of multiple cutting-off tool cannot be employed, this device will be found to give good results and it is simple and inexpensive to construct.

Middletown, N. Y. DONALD A. HAMPSON

HAND FRICTION CLAMP

A one-hand rapid-action friction clamp, designed for holding cylindrical work such as shafts, pipes, etc., is shown in the accompanying illustration. The work *W* is shown seated in the V-block *B*, clamped and in readiness for use. The clamping arrangement consists of two clamps, one of which, *A*, straddles the V-block, to the outside of which each prong is pinned; and the other, *C*, which is hung between the clevised part of clamp *A*, from a different center, provision for which is made by the slot cut in the V-block as shown at *S*. This inner clamp has an elongated hole and is hung thereby to block *B*, by means of the pin *D*. This arrangement allows any variation from the point of contact of the leather clamping strip *L*, to the leverage point *D* to be compensated for. These discrepancies will occur if the pin becomes worn or if the leather clamping strip, through repeated compression, becomes flattened or worn.



Hand Friction Clamp with Work in Position

The clamp is operated in the following manner: To release the work, the clamp is readily opened by forcing the handle *H* to the left. The edge *E* of the connecting piece of the prongs on *A* will thus be moved out of contact with the top camming surface of clamp *C* to about point *K*. The lug then comes in contact with the projections *F* on the inner clamp and both clamps then continue to open in unison. To close the clamp, the handle is pulled to the right until the edge *E* has forced the leather friction on the inner clamp firmly against the work. The amount of cam action due to the change in outline of the top surface of the inner clamp is represented by the distance *G*. This arc is swung from a different center than that on which the outer clamp is hung, the offset being indicated by distance *J*.

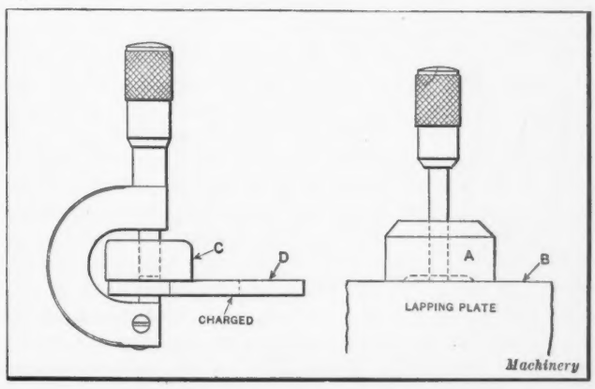
This device is a practical one and has been used on various types of fixtures, both vertical and horizontal, with very satisfactory results. It has also been used on trench periscope work in one of the factories of the Eastman Kodak Co.

Rochester, N. Y. JOHN DERNOGA

LAPPING WORN MICROMETER SPINDLE AND ANVIL

The method of lapping worn micrometer spindles and anvils shown in the accompanying illustration should be of general interest. The spindle is first removed and placed in a hardened steel block *A*, which is a sliding fit for the spindle and is used to hold the spindle perpendicular to the face of the lapping plate *B*. The plate is then moved back and forth until the end of the spindle is lapped perfectly flat. For lapping the anvil, the steel block *C* is bored for a wringing fit on the spindle, and after being wrung on, the flat parallel lapping plate *D*, which is charged on the side that rests on the anvil, is placed between the block and the anvil, as shown in the illustration. The anvil is then lapped and its surface is thus made absolutely parallel to the spindle end.

Hartford, Conn. J. SHAND



Lapping Micrometer Spindle and Anvil

DRIVING FIT ALLOWANCES FOR JIG BUSHINGS

Standard dimensions for driving fit allowances for jig bushings, arranged according to the outside diameter of the bushing, are given in the accompanying table. Oftentimes difficulty is experienced in assembling the bushings on account of not having allowed the proper amount of stock for fitting. This is especially true of the apprentice and inexperienced workman, and to such the table should be of especial value.

ALLOWANCES FOR DRIVING FIT FOR DRILL BUSHINGS

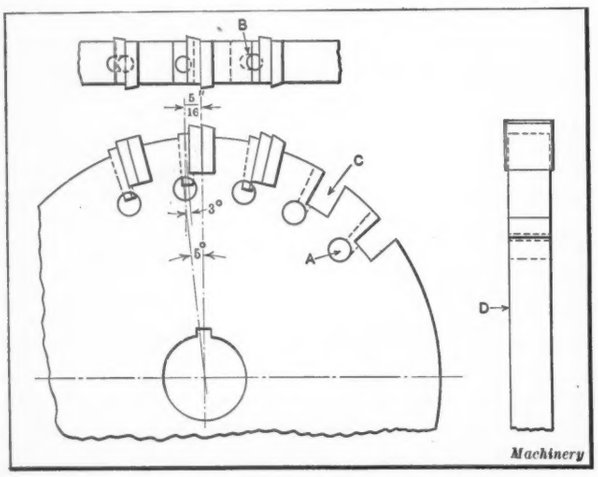
Outside Diameter, Inches	Allowance for Drive Fit, Inch	Outside Diameter, Inches	Allowance for Drive Fit	Outside Diameter, Inches	Allowance for Drive Fit
3/16	0.001	7/8	0.0015	1 5/8	0.0025
5/16	0.001	1	0.0015	1 3/4	0.0025
7/16	0.001	1 1/16	0.002	1 15/16	0.0025
1/2	0.001	1 1/8	0.002	2 1/8	0.003
9/16	0.0015	1 3/16	0.002	2 1/4	0.003
11/16	0.0015	1 5/16	0.002	2 7/16	0.003
3/4	0.0015	1 3/8	0.002	2 5/8	0.0035
13/16	0.0015	1 7/16	0.002	2 3/4	0.0035

Machinery

M. H. CHASE

INSERTED-TOOTH SLOTTING CUTTERS

Recently it was necessary to mill a slot through some bronze pieces and it was decided that an ordinary inserted-tooth cutter would be unsatisfactory, both on account of the wide spacing of the teeth and on account of the fact that every alternate tooth is driven through from opposite sides, in order to obtain the desired adjustment. As a means of overcoming these objections and at the same time in order to get practically double the number of cutting edges for a given size, a cutter was designed after the manner shown in the accompanying illustration.



Inserted-tooth Slotting Cutter of Special Construction

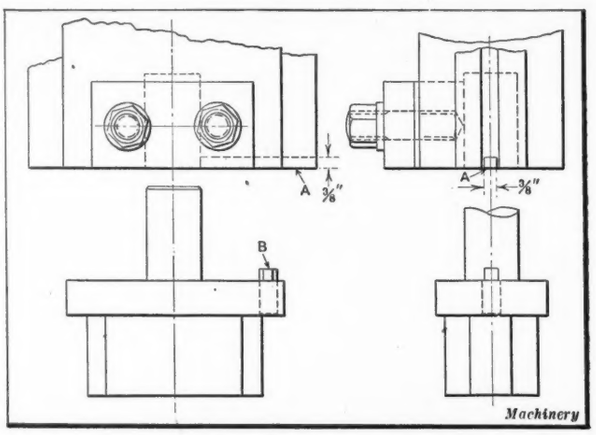
The body *D* is made of soft steel, and, after being turned in a lathe, it is set up on the dividing head of a milling machine where the 3/8-inch clearance holes *A* are spotted and drilled, after which the straight holes *B* are spotted, drilled, and reamed. The reaming of holes *B* must be carefully done, after which straight pins, made from drill rod, are driven in, care being taken to see that they are a snug fit and yet not so tight but that they may be readily driven out again. The cross-slots *C* are next milled out, being made wide enough to allow two blades to be inserted instead of one, as in the ordinary type of cutter. It will be seen from the illustration that at the same time that the slots are milled, one side of each of the pins is milled at an angle of 3 degrees with its center.

The cutter blades are next finished, being hardened and ground on their flat sides until they can be lightly driven into their respective slots, after which the pins are driven in, the angular milled sides wedging the blades firmly in place. The cutters may now be slipped onto a mandrel and the cutting edges ground. With this type of cutter, in which the number of cutting edges is doubled, chatter is minimized and smoother work is produced for a given feed than is possible with the ordinary type.

New York City DONALD A. BAKER

PRACTICAL METHOD OF SETTING DIES AND RESETTING PUNCHES

Diemakers and die-setters who know how hard it is to fit a punch into a die after upsetting it will appreciate the following simple method used to overcome this difficulty. This method has been practiced by a large metalware concern for several years with satisfactory results. At the lower face of the ram shown in the accompanying illustration at *A*, a 3/8- by 3/8-inch slot is milled from the bore straight out to the edge. A pin *B*, fastened to the top plate of the punch as far away from the stem as possible, is filed to fit the slot in the press. The die and punch are set up in the press and a blank is cut. The punch is then taken out and upset wherever the blank shows a burr. After the cutting face is filed even, the punch is set back into the press, the excess metal is sheared, and the die is put into working condition.

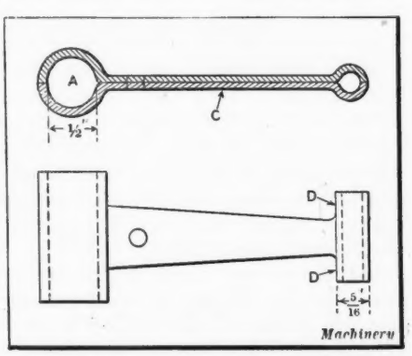


Method of setting Dies and resetting Punches

Plainfield, N. J. HENRY DAUT

CARBURIZING THE ENDS OF A CONNECTING-ROD

In the accompanying illustration is shown a pressed-steel connecting-rod used on pneumatic drills. In order to obtain the required wearing qualities in these connecting-rods, it is necessary to carburize both ends at points *A* and *D*, leaving the neck *C* soft. This was originally accomplished by copper-plating the entire surface of the connecting-rods and then removing the copper plate inside the hole at *A* and on the small ends at *D* by polishing with emery cloth. The pieces were then subjected to a carburizing process. The copper plate served to limit the carburizing action to the polished surfaces



Connecting-rod used on Pneumatic Drill

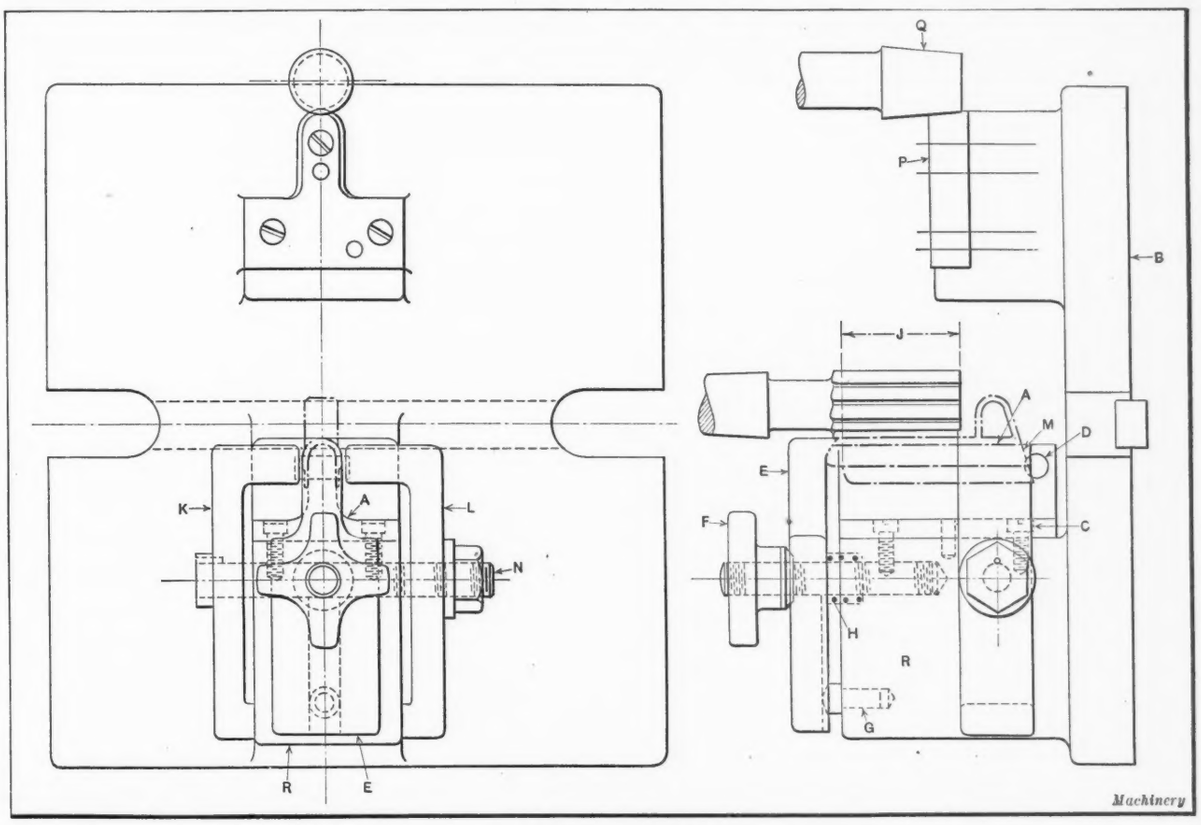
where the plating had been removed. This method, while giving satisfactory results, proved rather expensive, as the polishing operation was found to require considerable time.

In order to eliminate the necessity of performing the polishing operation by hand, several methods were tried out, the following one finally being adopted as satisfactory in all respects: Some ¼-inch thin rubber tube was purchased and cut into short lengths. These pieces were slipped over the ends at *D*. Also pieces of rubber hose were fitted into the hole at *A*. The connecting-rods were then copper-plated in the usual way. Assembling the connecting-rods with the rubber tubes, cost the company only 50 cents per 100 pieces and eliminated polishing, which had cost $5 per 100 pieces.

Aurora, Ill. JOHN J. BORKENHAGEN

PROFILE MILLING MACHINE FIXTURE

In the machining of pieces which have an irregular shape, it is quite often possible, by using a profile milling machine, to accomplish operations which by any other method would require either an elaborate fixture or a combination of operations. A job of this type is shown in the accompanying illustration. This piece requires the outside to be finished, and in order to accomplish this, the fixture shown is used. Before finishing the outside, the inside of the piece and the bevel *M* are machined by milling in the ordinary way.



Profile Milling Machine Fixture

To machine the outside, the piece is first placed in the fixture in the manner shown in the illustration. This fixture has a tool-steel block *A*, shaped to fit the finished inside of the work. This block is fastened to a lug *R* on the base of the fixture *B* by means of screws and dowels, as indicated at *C*. When set over this form block, the work rests against the pin *D*, one side of which is beveled to conform to, and provide a suitable stop for, the beveled edge of the work. A clamp *E* which has a hooked edge at the top is used to engage the other end of the work to hold it down against the pin *D* and against its seat on the form block *A*. This clamp is tightened by means of a hand-knob *F*, a pin *G* being used under the tail of the clamp. A spring *H* under knob *F* raises the clamp when it is loosened for removing the work.

The length of the cut to be taken on this piece is about two-thirds of its entire length, as indicated by *J*. The cutter is here shown in position for machining the work. In order to hold the work more adequately under the severe strain of this long cut, two clamps *K* and *L* are provided. These are tightened by means of a nut and washer, which draw up the bolt *N* and bind the work securely on the sides. It will be obvious that the work is thus rigidly held in such a manner as to make it almost impossible for it to become displaced under any severe cutting strain. A block *P*, which conforms to the shape that is to be milled on the piece, is suitably located so that the operator can follow the form to be milled by keeping the form plate in contact with the guide-pin *Q*, using the lever which is provided for this purpose on the machine. This fixture is cheaply built, and it has proved to be economical for the work described. H. M.

CUTTING WORM THREADS ON THE MILLING MACHINE

Worm threads may be satisfactorily cut on the milling machine, when a lathe is not available for use, provided the dividing head spindle is connected directly to the lead-screw of the milling machine. In one instance, an extended spindle had been previously used for differential indexing, as the dividing head was not provided with a differential attachment, and it so happened that the center distance between this spindle and the worm-shaft of the dividing head was such as to allow the use of standard universal milling machine gears. Accordingly, the worm and worm-wheel of the head were disconnected and suitable gearing was mounted on the spindle, the worm-shaft of the dividing head, and the lead-screw. Thus the motion of the milling machine lead-screw was transmitted directly to the extended spindle of the dividing head. By the use of universal milling machine standard gears, almost any worm having a full number of threads per inch may be cut. In setting the cutter at the desired angle a universal attachment is used. This method may be found of value in cases of emergency.

Milwaukee, Wis. D. E. MAPES

DEVELOPING A GAGING SYSTEM—A COMMENT

The series of articles on gages which has been published in MACHINERY during the past few months touches upon some interesting aspects of this important feature of modern quantity manufacturing systems, and a few remarks relative thereto may not be out of place.

Regarding working limit gages having three dimensions—minimum, mean, and maximum—the use of this type of gage is rarely met with. Referring to work being machined on the outside, in general, piece-work operators set the tools so that the work will pass the "Go" gage, regardless of whether it just passes, or whether the "Not Go" gage almost goes over. The first condition will be most commonly met with, with the result that when the tool wears it may soon leave the piece too large. If the tool had been set so that the work was sized to the mean dimension, a greater number of parts could have been machined before the wear of the tool would have caused the need for readjustment—with profit both to the operator and the employer.

With regard to the marking of gages, it is the writer's experience that the words "Go" and "Not Go" are preferable to the words "High" and "Low" or "Minimum" and "Maximum." Even men who are not able to speak the English language readily grasp the significance of the words "Go" and "Not Go."

The methods of procedure in developing a gaging system, as explained in the articles referred to are extremely good practice, but they are not commonly known nor used as often as they might be. The statements that relate to the determination of suitable tolerances (which, if properly determined, would save a great deal of time and expense in manufacture), are absolutely true. Considerable attention should be given to this important subject, and the methods in vogue not only in government departments but also in many manufacturing establishments need revision in this respect.

Another subject of great importance is dealt with under the sub-heading "Procedure in Making Drawings." The method of first making a functional design, followed later by an economy-of-manufacture design is excellent and yet not always followed. However, those who have engaged in work along the principles outlined can bear witness to the excellent results obtained by this two-stage arrangement. The cooperation necessary between the designer of a mechanism and the designer of tools and gages for the quantity production of parts is one of the cornerstones of economic production, both as regards quality and quantity. The most common method is for the inventor or designer of a mechanism to regard his own efforts as the last word and to place the responsibility upon others for converting his design into commercial products. Too often the designer so dimensions his work as to require it to be "too good," and only after quantity manufacture has been engaged upon are the real tolerances which can be used in practice established; hence, the fact should be emphasized that cooperation between the designer of the mechanism and the designer of the tools is of the greatest importance.

The tolerances given under the heading "Practicable Tolerances for Interchangeable Manufacture" in the October number are of great interest. A great many tool designers know that tolerances frequently given on parts that are required to be strictly interchangeable are so close as to absolutely prevent interchangeability when the parts are to be produced in a commercial manner. This has been particularly true of various kinds of guns and rifles. Regardless of all demands to put this problem on a modern manufacturing basis, in too many cases men whose experience in actual limit gage work is not sufficient insist that the close limits given can be obtained together with a high rate of production.

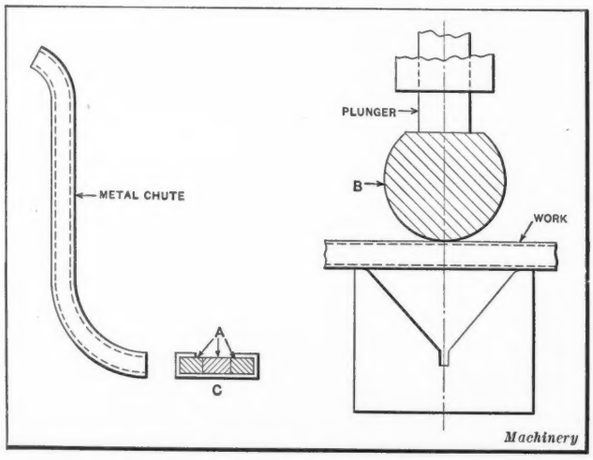
The subject of tolerances is, perhaps, the most important in the whole series of articles. That larger tolerances are permissible than is ordinarily believed possible is a truth not generally recognized. Paradoxical as it may seem, the product is often improved by larger tolerances, judiciously determined. In one case, for example, in a mechanism of which several hundred thousand were made, the male part was machined to a standard ring gage fit, and the female part was reamed to a standard plug gage; yet it was necessary that the parts move freely upon each other. To meet this requirement the male parts were subsequently filed by hand at the bench to permit of proper fitting in the assembling. The manufacture of this part would have been cheaper and the quality would have been very much improved if the large tolerance had been allowed from the beginning.

Another important point upon the subject of gages is that the gages themselves often can have a tolerance. This tolerance should be shown upon the gage drawing only, and not upon the gage itself. Much highly expensive labor can be saved by attention to this phase of gaging, with absolutely no detriment to the parts upon which the gage is to be used. Often the gage inspector has no alternative but to refuse to pass a gage which may vary only 0.0001 inch, and that in the direction of wear. Practice has shown it advisable to note upon the drawing both the plus and minus limits to which the gage can be made, and if no limits are permissible it should be so noted.

Bridgeport, Conn. ARTHUR JENNER

BENDING IRREGULAR CHUTES WITHOUT WRINKLES

It is often necessary to use sheet-metal chutes similar to the one shown in the accompanying illustration for feeding pieces of various shapes from hoppers to different parts of an automatic machine. It is rather difficult to bend the stock without causing considerable wrinkling in the



Method of bending Chutes without producing Wrinkles at the Bend

bends. A simple way to overcome this wrinkling and to produce a smooth bend is shown in the illustration. The flat stock is first bent to the form shown at *C*, three pieces of cold-rolled steel *A* being used, as shown, in forming the metal. The middle piece should be narrow enough so that it may be readily removed from the opening at the top. The stock is bent in a vise and the three pieces of steel are left within the chute until after the bending operation has been performed.

A piece of round stock *B*, is turned to the required radius, the work placed across a V-block as shown, and the plunger of a screw or arbor press forced down against *B* until the desired bend has been produced. If the pressure is applied gradually, no wrinkle of any kind will be in evidence. After the chute has been bent, the middle steel piece *A* is readily removed through the opening and the two side pieces are then brought to the center and also removed.

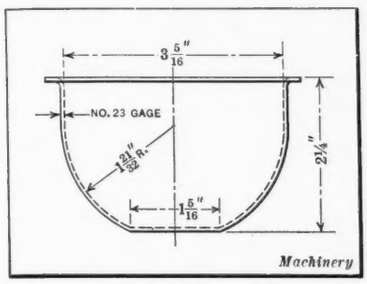
Reading, Pa. S. B. ROYAL

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

DRAWING A STEEL SHELL

F. A. M.—In the accompanying illustration is shown a cup-shaped shell drawn from No. 23 gage, soft steel. Can any reader of MACHINERY, who has performed a drawing operation of this kind and on materials of practically the same size and thickness, give a description and show actual drawings of the dies used for this work? The work is to be performed on a single-action press—preferably in one operation.



Cup-shaped Steel Shell to be drawn on a Single-action Press

PROBLEM OCCURRING IN GAGE WORK

W. A. J.—It is required to determine the distance between the points of tangency of a line with the studs shown in the illustration, and the angle formed by the line of tangency. If the horizontal and vertical center distances are known, and also the diameters of the studs, how can the other dimensions be found?

Answered by John W. Adams, Bridgeport, Conn.

By the conditions of the problem, L and D are known, also the radii R and r. It is then required to find the value of A, and of angle x.

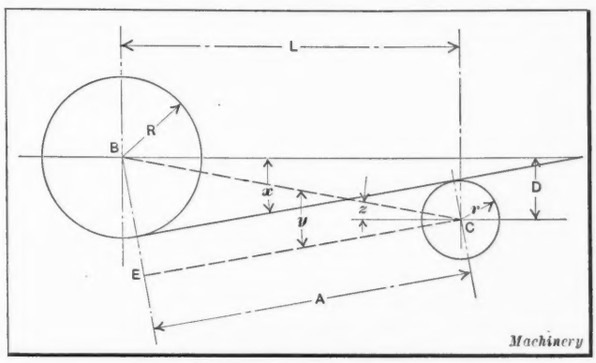


Diagram illustrating Problem in Gage Work

Draw line BC, also draw line CE parallel to the line of tangency.

$BC = \sqrt{L^2 + D^2}$; $BC^2 = L^2 + D^2$; $A = \sqrt{BC^2 - (R + r)^2}$

Substituting for BC^2 in the last equation:

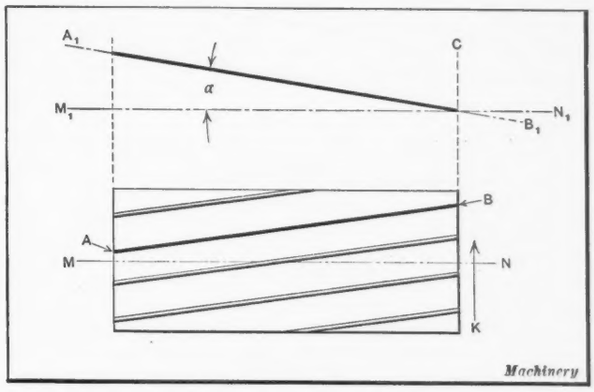
$$A = \sqrt{(L^2 + D^2) - (R + r)^2}$$

$\text{Tan } y = \dfrac{R + r}{A}$ and $\tan z = \dfrac{D}{L}$. Knowing the values of y and z, angle $x = y - z$.

METHOD OF FINDING LEAD OF SPIRAL MILLING CUTTER

J. A. J.—How can the lead of a spiral milling cutter, like the one shown in the accompanying illustration, be determined from the cutter itself?

A.—In order to determine the lead, it is first necessary to obtain the angle between the teeth and the axis of the cutter. A practical method of finding this angle is to coat the land or edge of one of the teeth, as AB, with some marking material, such as black-lead, and then roll the cutter upon a flat sheet of paper in the direction shown by arrow K. The contact between the spiral, or more properly, helical edge of the cutter tooth and the paper will form a straight line A_1B_1. In order to determine the angle it may be preferable to extend this line by means of a straightedge. Another line M_1N_1 is then drawn, to represent the axis of the cutter at right angles to line C along which the cutter was rolled. The next step is to measure this angle a by means of a protractor. The lead of the spiral or helix for any circumference is then determined by multiplying this circumference by the cotangent of the helix angle just measured. For instance, if the circumference were 12 inches and the



Method of determining Angle between Teeth and Axis of Spiral Milling Cutter

cotangent of angle a were 4, the lead of the spiral would be 12 times 4, or 48 inches. The cutter might be rolled along one edge of the sheet, or, all of the teeth could be covered at one end with marking material to locate line C.

A TOOLMAKER'S PROBLEM

J. A.—Will you kindly show me how to find the correct diameter of a plug which will be tangent to the sides of a snap gage as shown in the illustration? The 2-inch dimension and the 15-degree angle are all that is known.

A.—Erect OD and OE, perpendicular to AC and AB, respectively. Also, draw OA and OB. According to geometry, these lines will bisect angles CAB and the 90-degree angle at B.

CAB = 90 degrees + 15 degrees = 105 degrees

Then angle a = 52 degrees 30 minutes

Also, angle OBA = 45 degrees

Angle b = 180 degrees — (a + OBA) = 82 degrees 30 minutes

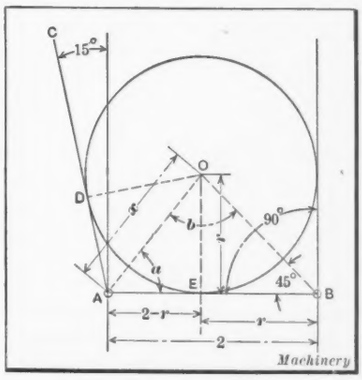


Diagram for finding Diameter of a Plug that is Tangent to the Sides of a Snap Gage

In the triangle OAB,

$$x = \frac{2 \times \sin OBA}{\sin b} = \frac{2(0.70711)}{0.99144} = 1.4264 \text{ inch}$$

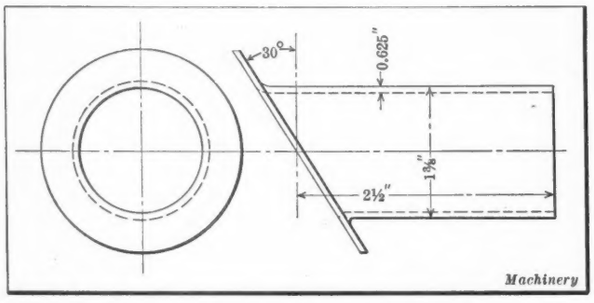
In the triangle OAE,

$r = \sin a \times x = 0.79335 \times 1.4264$ inch $= 1.1316$ inch

Diameter $= 2r = 2 \times 1.1316$ inch $= 2.2632$ inches

A DIE PROBLEM

G. K.—Referring to the accompanying illustration of a steel stamping, the question arises as to whether the job would be considered practical as a die job, and what would be the best method to pursue. Would it be better to start the draw at an angle with the flange, or to make a straight



Sheet-metal Part which it is proposed to draw in a Die

draw and form the flange at an angle afterward? The proposition is submitted to MACHINERY'S readers, with the hope that some valuable and practical suggestions may be offered.

INCREASED-TWIST AND CONSTANT-ANGLE DRILLS

A. S. D.—What is meant by "increased-twist" and "constant-angle" drills?

A.—To give a drill sufficient strength to withstand the torsional strain to which it is subjected in use, the grooves are constantly decreased in depth from the point to the shank. In order to retain a groove of sufficient area to prevent the chips from clogging near the shank as a result of the decreased depth of groove, two methods of cutting the groove have been evolved. The two types of drills produced by these methods are known as "increased-twist" and constant-angle" drills. In cutting the increased-twist drill grooves, the cutter remains at the same angle with the axis of the drill throughout the length of the groove, and the speed of rotation of the drill remains constant, but the forward traverse of the drill, as it is fed against the grooving cutter is constantly increased as the shank of the drill approaches the cutter. This results in a change in the angle of the cutter to the groove, producing a wider groove at the shank. The constant-angle drill is fed against the grooving cutter at a constant rate of forward traverse and a constant speed of rotation, the increased width of groove at the shank being produced by a gradual variation of the angle of the cutter to the axis of the drill as the shank approaches the cutter. The constant-angle drills are considered by many drill manufacturers to be superior to the increased-twist drills.

DETERMINING ERROR IN THREAD ANGLE BY THREE-WIRE METHOD

A. R. W.—What is the method of testing the angle of a screw thread by the three-wire system and how can the amount of the error be determined?

A.—The angle may be tested by comparison with a standard gage which is known to be correct or it can be determined by measurement and calculation. In either case wires of two diameters are employed. The diameter of the small wires is usually approximately 0.6 times the pitch of the thread to be measured and the diameter of the large wires about 0.9 times the pitch. The small wires must, of course, be large enough to extend above the top of the thread and, on the other hand, the large wires should bear at some point below the top or upper corner.

If a standard plug gage is available the difference between the measurements over the two sets of wires is first determined; the part to be tested is then measured to see if there is the same difference in measurement. When no standard plug is at hand and the accuracy of the thread is to be determined by measurement and calculation, the total difference between the measurements over the large and small sets of wires is first determined. If the thread is a U. S. standard or any form having an angle of 60 degrees, the difference between the two measurements referred to should equal six times the difference between the radii of the wires used. Assume in this case that the wires are 0.116 and 0.076 inch in diameter, respectively. The difference between the radii of the wires then equals 0.058 — 0.038 = 0.020. Hence, the difference between the micrometer readings for a standard angle of 60 degrees equals 6 × 0.020 = 0.120 inch.

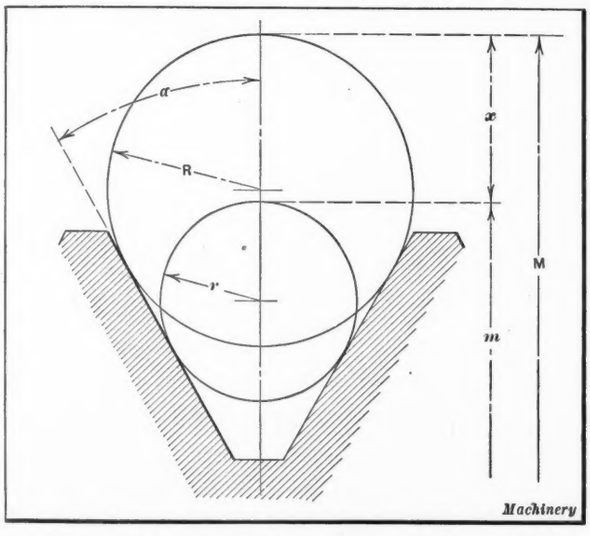
If the angle is incorrect the amount of error may be determined by the following rule: Subtract the radius of the small wires from the radius of the large ones and call this difference value No. 1. Next, subtract the radius of the large wire from one-half the difference of the two micrometer readings and then add to this difference the radius of the small wires, thus obtaining a value designated as No. 2. Now divide value No. 1 by value No. 2, thus obtaining the sine of one-half the included thread angle. This angle is then determined by referring to a table of sines.

The preceding rule may be expressed by the following formula:

$$\sin a = \frac{R - r}{x - R + r}$$

In this formula a equals one-half the thread angle, R equals radius of the large wires, r equals radius of the small wires, and x equals one-half the difference between the two micrometer measurements. (See accompanying illustration.) To illustrate the use of this formula, assume that the radius of the large wires is 0.058 inch and of the small wires 0.038 inch as in the preceding case. We shall further assume that a measurement over the two sets of wires shows a total difference of 0.122 inch instead of the correct difference (0.120 inch) for a standard angle of 60 degrees when using the sizes of wires mentioned, as was previously determined. In this example,

$$\sin a = \frac{0.058 - 0.038}{0.061 - 0.058 + 0.038} = \frac{0.020}{0.041} = 0.4878$$



Factors required for determining Angle of Thread by Three-wire Method

By referring to a table of sines it will be seen that this value 0.4878 is the sine of 29 degrees 12 minutes, approximately; therefore the angle of the thread is 58 degrees 24 minutes, or 1 degree 36 minutes less than the standard angle.

* * *

Reductions of from 25 to 30 per cent in freight rates from Atlantic ports to ports in South America, Asia, Japan, Australia, and Africa have been announced by J. H. Rosseter, Director of Operations of the Shipping Board.

Industrial Readjustment

Labor Readjustment—Training of Labor—Representation of Employes—Automobile Industry—Foreign Trade

LABOR READJUSTMENT ACTIVITIES

THE adoption of a system of part-time employment at the Watertown Arsenal, Watertown, Mass., to facilitate the redistribution and readjustment of labor is an action which may be advantageously followed by many employers who, under present conditions, find it necessary to make large reductions in the number of workmen that they employ. The entire plant at the Watertown Arsenal will close Fridays and Saturdays, thus enabling a long notice of discharge to be given to about 4200 men whose services are no longer required. This will allow the discharged men a longer period of time in which to obtain new positions before leaving their present jobs.

Labor Department's View of Employment for Labor

The following statement relating to employment of labor in the United States has been prepared by Assistant Secretary of Labor, Louis F. Post, after an investigation into the present conditions of the labor market and the situation in large manufacturing centers: The Department of Labor does not look forward to any unemployment crisis. There is no reason why either business men or wage-earners should be apprehensive with regard to commercial stagnation. The war has, on the whole, increased the purchasing power of the masses and has created new markets. America must assist in the rebuilding of Europe, and avenues for foreign trade hitherto closed to us are now open. Raw materials which were denied to private and non-essential industry during the war are now accessible to the manufacturers of America through their release by the War Industries Board. Credits which were similarly denied to private concerns because they were needed for government use have also been released by the Capital Issues Committee. There is no reason for anyone to be alarmed over the future.

Proposed Public Works for Absorption of Labor

It must be remembered, however, that we have large numbers of men under arms who must be transferred to industry as rapidly as possible and that this number is many times larger than that which we have been accustomed to absorbing. Industries cannot be resumed over night. As a consequence, for some months to come there will be the necessity for providing some form of employment for our demobilized soldiers and war workers, pending the resumption of normal activities. Obviously, the best course is to stimulate work which is valuable for peace-time purposes. Many municipalities throughout the country, and many states as well, have during the war either abandoned or suspended considerable amounts of public improvements. The Federal Government itself has practically abandoned its building program for the last two years. This accumulation of work should be undertaken at once as a means of providing employment to carry us beyond the transition period and take up such unemployment slack as may result not so much from the inability of the industries eventually to absorb demobilized soldiers and war workers, as from the rapidity with which they will be required to absorb them. There is also a scarcity of farm labor which needs to be met.

Duty of the Industries to Crippled Soldiers

The Red Cross Institute for Crippled and Disabled Men, 311 Fourth Ave., New York City, makes an appeal to manufacturers on behalf of the crippled soldiers that are now returning from the front. The Government will give these men, in addition to medical care, special training for self-support, but after they have acquired this training, the attitude of the manufacturer, as the prospective employer, becomes the important factor. The disabled soldier should not be assumed to be helpless or persuaded by charity to become so. All he needs is the kind of job for which he is fitted. There are hundreds of seriously crippled men who are now employed at important work in many factories, especially in the Ford plants. "In the past," states the Red Cross, "we have done everything possible to make the cripple a failure by lavishing upon him sympathy and charity, instead of giving him a real opportunity to take his place in the world with the rest of the useful people."

The responsibilities to the men disabled in the fighting include giving them proper training for some work which they can still perform in spite of their handicap, so as to make them self-respecting, and make life for them really worth living. In other words, the crippled soldier is entitled to a square deal, and it is for the manufacturers who employ labor to assist in giving this to them. They ask for no charity, require no expenditures—only an opportunity to work—and expect to give full value for the wages paid them. Find real jobs for them which they can hold with self-respect and without feeling that they hold them down as a matter of charity. Reserve those jobs for crippled soldiers that can be performed as well by them as by a fully able-bodied man.

Department of Labor Urges the Training of Labor for Peace Time

The United States Department of Labor is endeavoring to induce employers to continue the methods of training employes for peace-time work in the same manner as was done in many instances under war conditions. It is pointed out that $200,000,000 is wasted every year in the United States by excessive labor turnover. Officials of such large concerns as the General Electric Co. have declared that the cost of hiring a man runs from $10 to $200, and that the average charge against the employer in the discharge of one man and the hiring of another is $50. This is a loss that can be largely avoided by proper training and proper working conditions. The constant change in industrial organizations is a tremendous hindrance to production and to satisfactory returns both to capital and to labor. It requires a heavy investment—or rather expense—for unproductive effort; it is an outgo that bears little or no relation to output, and American manufacturers should do everything in their power to guarantee for themselves a stable system of production by a stable working force.

One of the principal factors in labor turnover is the failure of manufacturers to obtain from their workers, by proper training, a full measure of efficiency, and hence their inability to pay the wages to which the highest efficiency would be entitled. That this failure is generally ascribable

to the management is, according to the Department of Labor, indicated by the results obtained in establishments where proper training methods have been introduced. Furthermore, in an investigation in one large manufacturing concern, it was found that only 10 per cent of the dismissals, when properly analyzed, were due to inefficiency on the part of the worker, while 90 per cent were attributable to shortcomings of one sort or another on the part of the management. Another survey showed that 90 per cent of the men that left their employ did so on account of causes that could have been removed by the management, and which would have aided in increasing the production.

Reasons for Failure to Obtain Full Efficiency from Labor

Six general reasons are assigned for the inefficiency of production, five of which may be removed by vigilant management. The sixth is inefficiency or incompetence on the part of the employe. The five reasons for which the management is held responsible are: (1) Failure of power. (2) Failures of equipment. (3) Lack of proper instructions. (4) Lack of systematic training. (5) Failure to supply materials in time.

A special service known as the "training service" has been instituted by the Department of Labor, which is designed and equipped to assist manufacturers in making their labor efficient, productive, and profitable. There are now two hundred training rooms or schools in the United States in operation, 90 per cent of which are conducted without direct cost to the employer, because they are made self-supporting by the manner in which they are run. Employers generally are urged by the Government to adopt some system of training, providing their plants are large enough to warrant such a departure. From the investigations that have been made, there is no doubt that the efficiency of our factories can be greatly increased by preventing excessive labor turnover, thereby stabilizing the factors that prevent the highest efficiency from being obtained.

Plan for Representation of Employes in Dealing with the Management of an Industry

The Inland Steel Co., Indiana Harbor, Ind., has recently placed in operation a carefully worked out plan of employe representation, stating that it is established "in order to provide effective communication and means of contact between the management and the men on matters pertaining to industrial relations, and to insure justice, maintain tranquility, and promote the general welfare."

The employes' representatives shall be elected by secret ballot for a term of one year. Representation shall be on the following basis: Departments employing under 500 employes shall have one representative for each 100 employes; and departments employing over 500 employes, one representative for each 150 employes; but the latter must not have less than five representatives. The nominations and elections shall be conducted by the employes in accordance with rules and regulations prescribed by the committee on rules and shall receive only such assistance from the management as may be required by this committee.

The company shall appoint a management's representative who shall keep the management in touch with the representatives, and represent the management in negotiations with the representatives, their officers, and committees. It shall be his duty to interview all the representatives at least once a month with reference to matters of concern to the employes, and to report the results of such interviews to the management. Immediately following their election, the representatives shall meet for the purpose of electing a chairman, secretary, and committee on rules, and such other committees as shall be found necessary, to consider the following subjects: Wages, employment, and working conditions; housing, domestic economy, and living conditions; safety and the prevention of accidents; health and sanitation; transportation of employes; work's practice, methods, and economy; education; recreation and athletics; continuous employment and reconstruction problems.

The procedure for adjustment on any matter which, in the opinion of any employe, requires adjustment and which such employe has been unable to adjust with the foreman of the department in which he is engaged, may be taken up by such employe either in person or through any representative of his department, first, with the superintendent of the department; second, with the management's representative; third, with the superior operating officers of the company, who shall endeavor to make a settlement, or who may, with the approval of all the parties, refer the matter to a joint committee.

If, after a reasonable length of time, satisfactory disposition of such matter cannot be accomplished by a general joint committee on appeals, the matter shall be referred to an arbitrator, or arbitrators, agreed upon by the president of the company and the majority of the employes' representatives.

The New Government Working Conditions Service

The Working Conditions Service of the Department of Labor, Washington, D. C., has been organized to furnish the industries of the country with a service covering investigations and suggestions relating to sanitary and safety standards, measures necessary to prevent physical disability, and problems in connection with employment management. This service is distinct from that performed by the mediation and conciliation branch, which deals with working conditions and industrial relations as controversial issues between employers and employes. The Working Conditions Service deals with matters that have nothing to do with occasional controversies, such as industrial hygiene and medicine, safety engineering, and health service. The Department of Labor offers by this service assistance to owners and managers of industrial establishments in working out labor policies and standards for hygiene and safety.

* * *

PROSPECTS IN THE AUTOMOBILE INDUSTRY

The automobile industry will absorb the surplus stocks of automobiles and motor trucks that are now in the hands of the War Department. An agreement to this effect has been made between representative automobile manufacturers and War Department officials. The action was taken to prevent the disorganization of the business by a possible flooding of the market with automobiles owned by the Government. Present indications are, however, that the cars and trucks controlled by the War Department will be needed for some time in government service, and that, for that reason, there would be comparatively little disturbance of the industry even if the present arrangement had not been entered into.

Future Development of the Motor Truck Industry

Although manufacturers are now permitted to resume production of trucks for civilian use it will probably be about six months before anything like maximum production is obtained. The number of motor trucks now in use in the United States is approximately 500,000, and notwithstanding the limitations placed upon the production of commercial trucks by war conditions, there were nearly twice as many civilian trucks produced in 1918 as in 1917, the total production in 1918 being over 180,000. As regards transportation by horse-drawn vehicles, it is estimated that there are about 25,000,000 horses and 10,000,000 wagons suitable for business purposes. The increasing demands on transportation efficiency will probably make it necessary to replace many of these horse-drawn vehicles by motor trucks.

Extended Use of Motor Trucks

The establishing of hundreds of rural motor-truck lines throughout the country is proving of great benefit to the farmers who can now make daily shipments of farm products to the city and can have delivery made at their homes of any articles they may require from the city. The Post

Office Department has already established motor postal routes between some of the larger cities which handle all kinds of farm produce and merchandise as well as first-class mail. These lines have proved so successful that the department has made plans to extend this service throughout the country. This work may be more rapidly accomplished than would otherwise be possible by employing the 1½- to 3-ton trucks which have been made for war purposes. It is claimed that not only are these trucks suitable for use on the postal routes planned by the Post Office Department, but that use can also be made of the standardized Type B military trucks for heavy transfer work. It is not probable that any of the army trucks which have been shipped abroad will be returned to this country, but on the other hand, many more will be needed for reconstruction work in Europe. There can be no doubt but that American trucks will find a ready market abroad in the future, for the performance of American-built trucks in France during the war has gained for them a most satisfactory reputation for reliability and service, and our manufacturers are in a position to furnish the large numbers of trucks which will be required in carrying out the work of reconstruction.

The use of motor trucks by the railroads, whether or not they continue to be operated by the Government, will probably be found necessary, for in order to compete with motor truck transportation, they will be required to extend their service so as to include local deliveries, as do the express companies. With the many opportunities and new fields open to motor-truck transportation it is evident that the motor truck industry is certain to experience a rapid development and expansion in the near future.

The Revised Steel Prices

With regard to the new steel prices, the following figures will prove of interest: The average of eight representative steel products under the new price schedule is $70.95 a ton, which is only $1.17 under the price which prevailed in December, 1916, and which was then regarded as an extremely high level. The new schedule of prices averages $30 a ton more than the highest price previous to the war, which was $40.68 and which was reached in 1907. It is evident, therefore, that the present reductions in steel prices will by no means bring steel anywhere nearly back to the pre-war prices; in fact, the present price is, in many instances, about double that previous to the war.

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FOREIGN TRADE NOTES

The following information transmitted to MACHINERY by the Belgian Consulate in New York City, will be of value to manufacturers: The Belgian Government recommends, as the best Belgian organization with which American merchants and manufacturers can deal, the "Comite Central Industriel de Belgique," 11 rue du Gentilhomme, Brussels. The Government is compiling information relating to the present conditions of the Belgian industry, and the "Comite Central Industriel Belgique" is requested to prepare lists of the names and addresses of Belgian firms who handle the principal articles. These lists will be available later through the Belgian Legation at Washington.

What France Needs

Commercial Attaché Pierce C. Williams, of the Department of Commerce, cables that France needs for the rehabilitation of its devastated areas and its damaged industries, first, labor; second, raw materials to keep the French industries going; third, machinery and equipment for iron and coal mines, steel works, textile mills, and other industrial establishments in France which the country is not now in a position to manufacture in sufficient quantities; and, fourth, ships. As to the equipment for the rebuilding of industrial plants, the French industries have already collected data as to exactly what they need and are ready to place orders through the French High Commission in Washington just as soon as shipping facilities can be provided. It has been suggested that the best way for American industries to aid the French buyers would be by organizing group selling so as to facilitate French collective buying. As soon as practicable, these selling groups should then send properly trained engineers to France, who could deal with French engineers regarding the equipment required.

Resumption of Trade with Alsace-Lorraine

The War Trade Board announces that all persons in the United States are authorized, subject to the rules and regulations of the War Trade Board, to trade and communicate with persons residing in Alsace and Lorraine. In accordance with this authorization, applications will now be considered for licenses to export or import all commodities to and from Alsace and Lorraine. For the exportation of articles which are not on the export conservation list, individual export licenses will not be required. Applications for the exportation to Alsace and Lorraine of commodities which are on the export conservation list should be filed in the same manner as applications for licenses to export to France. For importations into the United States from Alsace and Lorraine, individual import licenses will be required, on the same conditions as for importations from other European non-enemy countries, except where the shipments are covered by the list of general import licenses.

Reconstruction Plans for Devastated Regions in Europe

A plan for the reconstruction of the devastated areas in Europe has been proposed whereby the building material and equipment now owned by the United States Government, both here and in Europe, and which was purchased for war purposes, should be employed in the reconstruction work abroad. The United States should assume the financial responsibility and include the reimbursement necessary in the restitution bill against Germany. This plan would make it possible to proceed with the reconstruction work immediately, and under proper control and supervision, and it would make it possible to employ the present governmental organizations instead of creating new organizations for the purpose. Furthermore, the equipment would be immediately turned to productive uses, instead of waiting for the organization of new agencies to take charge of the reconstruction work. An arrangement between the French and the United States Governments to this effect would probably be all that would be necessary to start work at once.

Bureau of Commerce Sends Representative to Study European Trade

Chauncey D. Snow, assistant chief of the Bureau of Foreign and Domestic Commerce, will study reconstruction and commercial problems in Europe during the coming year, and will visit England, France, the Scandinavian countries, Holland, Switzerland, and Italy. It is believed that his studies will be of considerable importance to the export business of American industries. He has formerly done similar work, having been connected with the Bureau of Foreign and Domestic Commerce for eight years and being the author of "German Foreign Trade Organization" and "German Trade and the War."

Russian-Pacific Trade Expansion

The first number of a periodical entitled "Russian-Pacific Trade Expansion," which is the journal of the Russo-American Committee for the Far East, has recently made its appearance. The magazine is published, partly in English and partly in Russian, at Vladivostok, Siberia. The Russo-American Committee for the Far East was formed in December, 1917, to promote close industrial and commercial relations between America and Russia. It may be reached through the Central War Industrial Committee of Russia, which has headquarters in New York City at 1014 Flatiron Bldg.

JOHANSSON SYSTEM OF TOLERANCES

The tolerances given in Table 1 have recently been adopted by Aktiebolaget C. E. Johansson, Eskilstuna, Sweden, and have been furnished to MACHINERY by the Swedish Gage Co., New York City. The tolerances as given in the original table furnished were expressed in the metric system, but for convenient use in American machine shops, they have been translated into inches. The tolerances are based upon the diameter of the hole as the standard. The values in the first two subdivisions of the table, headed *A* and *B*, respectively, apply to the tolerances for the plug gage for the hole, the values in column *A* being for ordinary work, while those in column *B* are used where smaller tolerances are required. The values in the other subdivisions of the table apply to the tolerances allowed on the shaft. These values include tolerances for a light running fit, running fit, sliding fit, push fit, easy driving fit, close driving fit, and forced fit. The accompanying diagram graphically illustrates the application of these tolerances both in regard to the hole and to the shaft. In the illustration, the exact values to five decimals given in Table 1 have not been reproduced, but instead, the nearest values to four decimals have been given, as this is as close as could ordinarily be measured.

Table 2 gives the tolerances which are employed in the Johansson shops in the making of gages. These tolerances are given both in millimeters and in inches, for comparison. The values headed "Standard Cylindrical Gage," relate to plug gages used as reference standards. The values headed "Shop Gage," refer to working gages.

The tolerances for shop gages in Table 2 are determined by the following formulas:

For diameters 70 millimeters and under:

$$\text{Tolerance} = (0.28 + \sqrt[3]{D}) \div 2000,$$ in which D = diameter in millimeters.

For diameters over 70 millimeters:

$$\text{Tolerance} = (D \div 100{,}000) + 0.0015$$

TABLE 1. SYSTEM OF TOLERANCES WITH DIAMETER OF HOLE AS BASIC SIZE

Diameter of Hole, Inches	Hole (See Note)						Shaft		
	A, Inch			B, Inch			Light Running Fit, Inch		
	Minimum (Minus)	Maximum (Plus)	Tolerance	Minimum (Minus)	Maximum (Plus)	Tolerance	Minimum (Minus)	Maximum (Minus)	Tolerance
1/32 – 1/8	0.00016	0.00016	0.00032	0.00008	0.00008	0.00016	0.00083	0.00043	0.00040
1/8 – 1/4	0.00024	0.00024	0.00048	0.00012	0.00012	0.00024	0.00122	0.00063	0.00059
1/4 – 13/32	0.00031	0.00031	0.00062	0.00016	0.00016	0.00032	0.00165	0.00087	0.00078
13/32 – 23/32	0.00043	0.00043	0.00086	0.00024	0.00020	0.00044	0.00217	0.00118	0.00099
23/32 – 1 1/8	0.00055	0.00055	0.00110	0.00028	0.00028	0.00056	0.00276	0.00157	0.00119
1 1/8 – 1 7/8	0.00067	0.00067	0.00134	0.00035	0.00031	0.00066	0.00335	0.00197	0.00138
1 7/8 – 2 15/16	0.00083	0.00083	0.00166	0.00043	0.00039	0.00082	0.00402	0.00236	0.00166
2 15/16 – 4 17/32	0.00098	0.00098	0.00196	0.00051	0.00047	0.00098	0.00473	0.00276	0.00197
4 17/32 – 6 7/8	0.00118	0.00118	0.00236	0.00059	0.00059	0.00118	0.00551	0.00315	0.00236
6 7/8 – 10 7/16	0.00138	0.00138	0.00276	0.00071	0.00067	0.00138	0.00630	0.00354	0.00276
10 7/16 – 15 3/4	0.00157	0.00157	0.00314	0.00079	0.00079	0.00158	0.00709	0.00394	0.00315

Diameter of Hole, Inches	Shaft								
	Running Fit, Inch			Sliding Fit, Inch			Push Fit, Inch		
	Minimum (Minus)	Maximum (Minus)	Tolerance	Minimum (Minus)	Maximum (Minus)	Tolerance	Minimum (Minus)	Maximum (Plus)	Tolerance
1/32 – 1/8	0.00043	0.00020	0.00023	0.00020	0.00008	0.00012	0.00008	0.00012	0.00020
1/8 – 1/4	0.00063	0.00031	0.00032	0.00031	0.00012	0.00019	0.00012	0.00020	0.00032
1/4 – 13/32	0.00087	0.00043	0.00044	0.00043	0.00016	0.00027	0.00016	0.00028	0.00042
13/32 – 23/32	0.00118	0.00059	0.00059	0.00059	0.00020	0.00039	0.00020	0.00031	0.00051
23/32 – 1 1/8	0.00157	0.00079	0.00078	0.00079	0.00024	0.00055	0.00024	0.00031	0.00055
1 1/8 – 1 7/8	0.00197	0.00098	0.00099	0.00098	0.00031	0.00067	0.00031	0.00031	0.00062
1 7/8 – 2 15/16	0.00236	0.00118	0.00118	0.00118	0.00039	0.00079	0.00039	0.00028	0.00067
2 15/16 – 4 17/32	0.00276	0.00138	0.00138	0.00138	0.00047	0.00091	0.00047	0.00024	0.00071
4 17/32 – 6 7/8	0.00315	0.00157	0.00158	0.00157	0.00055	0.00102	0.00055	0.00020	0.00075
6 7/8 – 10 7/16	0.00354	0.00177	0.00177	0.00177	0.00067	0.00110	0.00067	0.00020	0.00087
10 7/16 – 15 3/4	0.00394	0.00197	0.00197	0.00197	0.00075	0.00122	0.00075	0.00020	0.00095

Diameter of Hole, Inches	Easy Driving Fit, Inch			Close Driving Fit, Inch			Forced Fit, Inch		
	Minimum (Plus)	Maximum (Plus)	Tolerance	Minimum (Plus)	Maximum (Plus)	Tolerance	Minimum (Plus)	Maximum (Plus)	Tolerance
1/32 – 1/8	0.00012	0.00024	0.00012	0.00024	0.00039	0.00015	0.00039	0.00059	0.00020
1/8 – 1/4	0.00020	0.00035	0.00015	0.00035	0.00059	0.00024	0.00059	0.00098	0.00039
1/4 – 13/32	0.00028	0.00047	0.00019	0.00047	0.00083	0.00036	0.00083	0.00146	0.00063
13/32 – 23/32	0.00031	0.00059	0.00028	0.00059	0.00110	0.00051	0.00110	0.00197	0.00087
23/32 – 1 1/8	0.00031	0.00071	0.00040	0.00071	0.00142	0.00071	0.00142	0.00252	0.00110
1 1/8 – 1 7/8	0.00031	0.00087	0.00056	0.00087	0.00177	0.00090	0.00177	0.00319	0.00142
1 7/8 – 2 15/16	0.00028	0.00102	0.00074	0.00102	0.00213	0.00111	0.00213	0.00394	0.00181
2 15/16 – 4 17/32	0.00024	0.00118	0.00094	0.00118	0.00256	0.00138	0.00256	0.00481	0.00225
4 17/32 – 6 7/8	0.00020	0.00138	0.00118	0.00138	0.00303	0.00165	0.00303	0.00579	0.00276
6 7/8 – 10 7/16	0.00020	0.00157	0.00137	0.00157	0.00354	0.00197	0.00354	0.00689	0.00335
10 7/16 – 15 3/4	0.00020	0.00177	0.00157	0.00177	0.00414	0.00237	0.00414	0.00808	0.00394

Machinery

Use column A for less accurate work, where greater tolerances are allowable. Use column B for accurate work, where smaller tolerances are required. The values, in inches, in the table above have been given to five decimals simply to give the exact value of the dimensions in millimeters in the original tables.

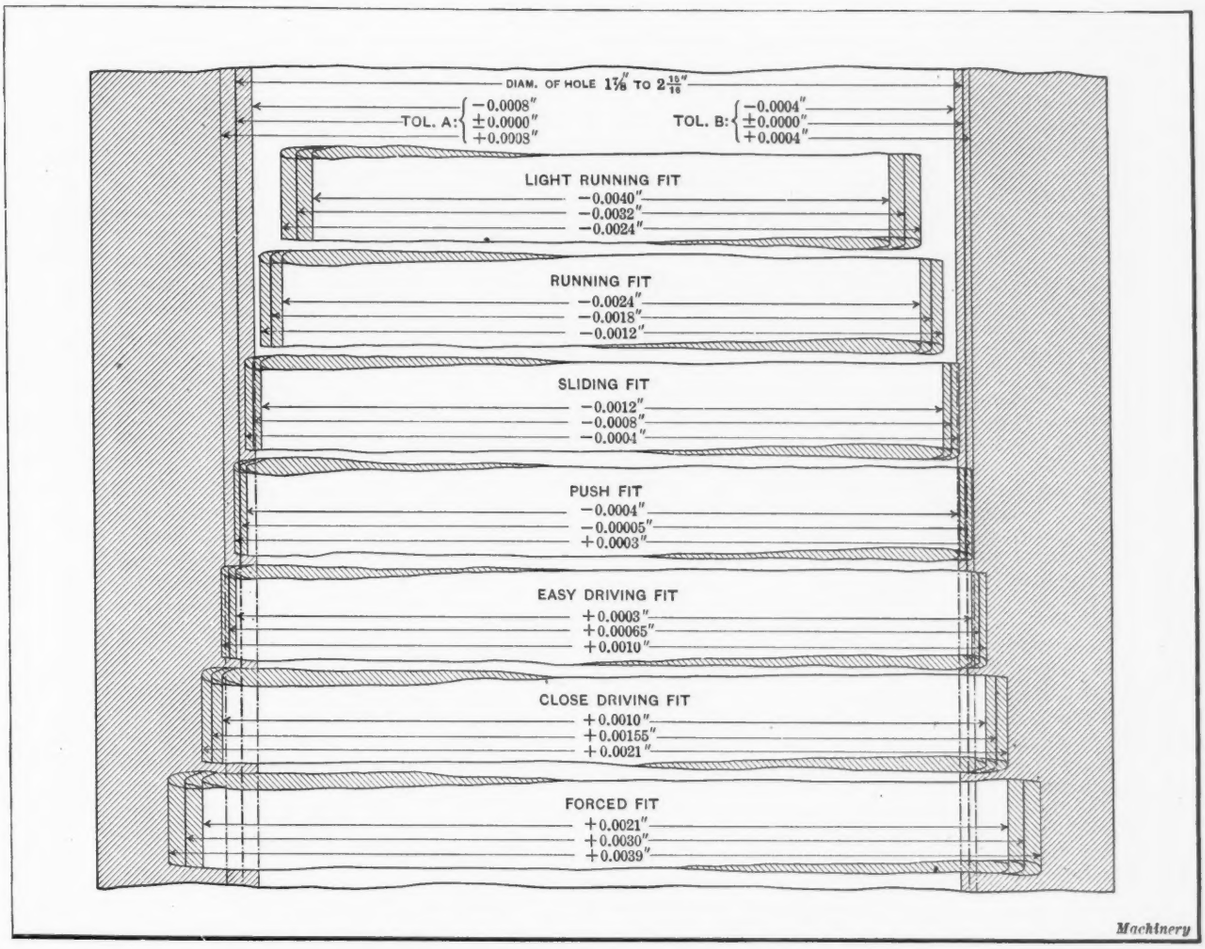

Diagram Graphically illustrating Fitting Tolerances based on Size of Hole

TABLE 2. TOLERANCES FOR GAGES

Diameter D		Standard Cylindrical Gage		Shop Gage	
Millimeters	Inches (Approx.)	Millimeter	Inch	Millimeter	Inch
1	1/32	0.0004	0.000016	0.0006	0.000024
2	5/64	0.0005	0.000020	0.0008	0.000032
3	1/8	0.0005	0.000020	0.0009	0.000035
4	5/32	0.0006	0.000024	0.0009	0.000035
5	13/64	0.0006	0.000024	0.0010	0.000039
10	25/64	0.0007	0.000028	0.0012	0.000047
15	19/32	0.0008	0.000032	0.0014	0.000055
20	25/32	0.0008	0.000032	0.0015	0.000059
25	63/64	0.0009	0.000035	0.0016	0.000063
30	1 3/16	0.0010	0.000039	0.0017	0.000067
35	1 3/8	0.0011	0.000043	0.0018	0.000071
40	1 37/64	0.0011	0.000043	0.0018	0.000071
45	1 49/64	0.0012	0.000047	0.0019	0.000075
50	1 31/32	0.0012	0.000047	0.0020	0.000079
55	2 11/64	0.0013	0.000051	0.0020	0.000079
60	2 23/64	0.0013	0.000051	0.0021	0.000083
65	2 9/16	0.0014	0.000055	0.0022	0.000087
70	2 3/4	0.0015	0.000059	0.0022	0.000087
75	2 61/64	0.0015	0.000059	0.0023	0.000091
80	3 5/32	0.0016	0.000063	0.0023	0.000091
90	3 35/64	0.0017	0.000067	0.0024	0.000094
100	3 15/16	0.0018	0.000071	0.0025	0.000098
125	4 59/64	0.0020	0.000079	0.0028	0.000110
150	5 29/32	0.0023	0.000091	0.0030	0.000118
175	6 57/64	0.0025	0.000098	0.0033	0.000130
200	7 7/8	0.0028	0.000110	0.0035	0.000138
250	9 27/32	0.0033	0.000130	0.0040	0.000157
300	11 13/16	0.0038	0.000150	0.0045	0.000177
350	13 25/32	0.0043	0.000169	0.0050	0.000197
400	15 3/4	0.0048	0.000189	0.0055	0.000217
450	17 23/32	0.0053	0.000209	0.0060	0.000236
500	19 11/16	0.0058	0.000228	0.0065	0.000256

Machinery

RECONSTRUCTION PLANS OF CANADIAN MANUFACTURERS

The Canadian Manufacturers' Association, in connection with the Trades and Labor Congress of Canada, has recommended the following specific proposals to the Canadian Government: The Government should establish a bureau of public welfare to deal with such matters as health, sanitation, accident prevention, etc., and to look into the matter of suitable homes for working-men in industrial centers. A permanent representative bureau should be established to make a survey of imports, with a view to ascertaining whether some of the goods imported could not be manufactured advantageously in Canada. The work of the Government done in the past relating to the refining of minerals mined in Canada should be expanded. At least $1,000,000 annually should be appropriated for scientific and industrial research. Necessary public works should be carried forward as promptly and energetically as possible. The advancement of technical education should be furthered by the Dominion Government. Educational facilities for the thorough training of soldiers who desire to settle on the land should be provided. The establishment of employment bureaus operated by the provinces in cooperation with the Federal Government is emphasized, and the absolute undesirability of private employment offices is pointed out and their abolition recommended. The Government should adopt a fixed policy on a comprehensive scheme with regard to the utilization of water powers already developed and those to be developed, and in order to give industry the proper freedom for expansion, the power supply should always be kept well in advance of the demand.

Readjustment in Great Britain and France

BY ALEXANDER LUCHARS[1]

INFORMATION lately received from a number of correspondents connected with the machine tool industry in Great Britain and France, on conditions in those countries, and various points with which the writer is familiar, are summarized in this article.

GREAT BRITAIN

The armistice was as unexpected in Great Britain[2] as in this country, and introduced conditions in the mechanical industries similar to those which prevailed in this country last November. Generally speaking, preparation for the transition to post-war programs is far from complete. Those firms who fortunately are able to continue their former lines of manufacture are going ahead full speed; others who had definite changes in view find themselves short of tool equipment and with jigs and fixtures in an incomplete state for their new product. The transition is rendered more difficult in the case of plants which before the war had not followed interchangeable manufacturing methods, as we employ them in the United States, but who have acquired in the last four years some entirely new experience in quantity production and other up-to-date methods on their war work, and are anxious to adapt it to their future product. There remains a third class, chiefly smaller concerns who have been caught napping and have no definite plans for the future.

Readjustment of War Industries to Other Lines of Manufacture

There is work, however, in abundance, and no difficulty should be found in keeping all the up-to-date works going. Motor car production is likely to be greatly increased over that before the war, as there is already a long list of waiting orders. The change over from war work is exemplified by such transitions as from fuses to electrical accessories; guns to locomotives; airplane parts to motor fittings, toys, ignition systems and hosiery needles. The possibilities in the way of new industries have been reviewed by the Ministry of Reconstruction which has made recommendations as to the following: Wire machinery, agricultural machinery, brazing lamps, reaper oil-cans, hurricane lamps, seamless milk cans, enamelled hollow-ware, bread baking machines, incandescent burners, sewing machines, typewriters and sheet-metal filing cabinets and furniture. Plans have already been formulated by a number of manufacturers with the necessary plant and experience for producing some of these lines.

Jig and tool makers are likely to be filled with orders, and in anticipation of the demand several large concerns are putting in equipment for this class of production. There are indications of a slight set-back in gaging equipment, which received a big stimulus on account of the war; but this doubtless is only temporary, as the demand under the new conditions should be co-extensive with that for jigs and tool equipment. At least three concerns have successfully entered the field for the manufacture of gages of the Johansson type, and look forward with confidence to meeting future competition.

Prospects of British Machine Tool Trade and Industry

In the machine tool industry, the first step toward freedom of action has been taken by the removal of restrictions upon the release of new machine tools and woodworking machinery, providing such machines are purchased from firms holding permits from the Ministry of Munitions. It is consequently no longer necessary for buyers to make application to the Ministry for release certificates before placing their order with the manufacturer or merchant. A considerable volume of business has been freed, the demand for standard machines being brisk in connection with the new reconstruction policy. Against this, however, must be placed the reduction in orders for war work and cancellations resulting from the armistice. The latter, however, are not serious and are chiefly associated with gun and shell plants. The demand for machine tools for shipbuilding and marine engineering machine tools continues; in fact, inquiries since the armistice have in some instances exceeded in number those received during the last two years.

Probable Effect of Second-hand Market

There is no present indication that any large number of machine tools installed for war purposes will be thrown on the market, inquiries up to date considerably exceeding offers of sale. It is certain, however, that as large numbers of tools employed in shell plants are now lying idle, they must eventually find their way on the market. A fair proportion of these will be high-grade tools capable of application to normal requirements, and consist chiefly of capstans (hand screw machines) and turret lathes which will need only a slight overhauling and a new tool equipment to enable them to be utilized. A very large percentage of second-hand tools are special machines, so that their application to production work other than that for which they were intended will not be easy. Many of these, together with the large number of machines that have been subjected to rough treatment, are more likely to find their way to the scrap heap than to the market.

British war production in machine tools has led to an optimistic official utterance to the effect that "there is no reason why Britain should not become independent of outside supplies." The output showed an increase of 66 per cent in 1917 over pre-war production, compared with the German increase of 23 per cent. The pre-war output was valued at £4,000,000 per annum, but increased in 1917 to £6,500,000, based on pre-war prices, or £10,000,000 at war prices. The official view, unfortunately, appears to have overlooked the almost total absence of automatic machinery makers in Great Britain, to say nothing of the relatively small proportion of makers of high-grade precision machine tools.

Research Work in Machine Tool Field

In connection with the government scheme for industrial and scientific research, the question of forming a Research Association for the machine tool industry has been considered by the Machine Tool Association, Ltd., which decided that the project should be favorably considered and a plan drawn up. Parliament has placed the sum of one million pounds at the disposal of the Department of Industrial and Scientific Research, and it proposed to use a great part of this money in assisting different trades to carry out researches likely to be of advantage to those trades. The procedure which is being adopted is the formation of research associations under the auspices of existing trade associations, and generally speaking the Government is prepared to grant such associations a sum equal to that subscribed by the members. Other important matters receiving careful attention from the association are the financing of long period contracts and the Imports and Exports Control Bill.

[1] Publisher of MACHINERY.

[2] See also January MACHINERY, page 464.

Labor Conditions, Employment of Women and Outlook for the Future

As regards labor, the displacement of the munition workers, male and female, is being met for the time being by the payment of "out-of-work" wages. The employment of women in the machine tool trade is not likely to be extensive in the future, their lack of shop experience and technical training having proved a handicap on anything except simple repetition machine work. Their prospects on mechanical work generally it is difficult to forecast, but the National Council of Women has appointed a Special Engineering Committee to give attention to the future of women who have attained some degree of skill and who wish to continue their work.

In Great Britain, as in this country, many enormous factories, not only for the production of munitions, but for all kinds of war material, will be closed, and although various rumors are circulated in regard to some of them being purchased for various purposes, nothing definite has yet transpired. Engineers and those connected with the machine tool industry in Great Britain look forward confidently to a period of great expansion and prosperity, and the definite plans they are making for the future are receiving substantial help and encouragement from the British Government—an example which our own Government would do well to follow. Only persistent efforts by our manufacturers will accomplish this.

FRANCE

Conditions in France are still too unsettled to afford definite information on some important points. Many of the plants equipped for manufacturing munitions will be adapted to a variety of work, such as the production of automobiles, motor trucks, tractors and some machine tools and small tools. The Citroën plant in Paris, mentioned in one of the writer's letters from Europe in 1916, which is strictly a shell-making factory, is to expand its equipment so as to build a light car similar to the Ford. The Ford Motor Co., by the way, has a large assembling plant at Bordeaux and as their enormous production brings their cost down to rock bottom and their machines are shipped "knocked down" so as to reduce freight cost to the minimum, the Citroën concern may find the Ford competition strenuous.

It is said that the great arsenal at Roanne, intended to employ some 50,000 workmen, is to be used principally for making locomotives and railroad material, and that the Etablissements Mayen, just outside of Paris, a large factory built to manufacture airplane motors, is to make textile machinery. It is generally thought that nearly all the French war plants will be turned over to peace-time products; but it should be remembered that there are not nearly so many war plants in France as in Great Britain.

Estimated Machine Tool Requirements in the Near Future

The French Ministry of Armament has had made an inventory of the machines in the arsenals to ascertain how many can be profitably used in general manufacture, and it is said that their lists show machines amounting in value to between 50 and 75 million francs that can be used in French factories. Some of these machines have been subjected to rather hard usage; but many are still in the cases in which they arrived, and a great many of the latter are standard machine tools of various kinds that can be used in the average large machine shop. Some of the machines not adapted to peace-time products can be placed in the Belgian arsenals, which, of course, were completely stripped. Many of the munition plants were largely equipped with standard machinery, using special jigs and fixtures, so there is less special machinery than might be expected.

In my opinion it is impossible to estimate yet what amount of tools will be required to re-equip the French plants dismantled or destroyed by the Germans. A well-known French dealer estimates that about 200 million francs worth of machine tools will be required within two years; or, say, 100 million francs worth a year in addition to a number of special machines, in the works of the devastated territory. In the reconquered territory of Alsace-Lorraine there are many machines too old or worn out by war work to be worth using, and these must be replaced. The value of machines required for this purpose he estimates at 50 million francs for 1919 for Alsace-Lorraine, and from 30 to 50 million francs for the rest of France. He also estimates that there can be made in France about 50 million francs worth of machinery during 1919, consisting principally of lathes, planers, punching and shearing machines, drilling machines, boring mills, a few radial drills and shapers. (The writer's opinion is that this last figure is much too large). The total amount of machine tools needed, according to this estimate, will therefore be about 180 or 200 million francs worth. The lists of the French Ministry of Armament show machines no longer required in arsenals and munition factories amounting to from 50 million to 75 million francs, which can be used in French factories, which leaves from 100 to 125 million francs worth to be bought.

A high official in the French ministry told one of our correspondents recently that they had requested the American Government not to dispose of any of their material in France—that is, machinery in the various United States repair shops, dock machinery, auto trucks, etc.,—to private concerns there; and that an agreement is practically made for the French Government to take over all of this material at the pre-war price. This seems almost too good to be true; but it comes to me on what I consider good authority. It is quite certain that the project is being pushed by one of the French departments.

Prospects of Competition with French Machine Tool Industry

It is not believed by authorities in the machine tool industry in France that there will be enough machine tools of the highest quality manufactured there to materially affect importations from America. Aside from engine lathes, plain milling machines and other simple machines, there will still be a good market for first-class American tools, because the French cannot turn out the higher grade machines, such as turret lathes, universal milling machines, automatic screw machines, etc., in sufficient quantities to so reduce their cost as to compete with the American product. Most users will prefer an American machine of reputation, even at a higher price, to a French machine that is an experiment.

Importance of Quality in American Machine Tools

When the writer was in France two years ago there was wide and bitter complaint about the quality of some of the tools sold there by our manufacturers, and those complaints still exist. Two well-known American manufacturers are flagrant offenders. One correspondent (not a dealer and not financially interested in any way) writes that all the ——— lathes sold in France during the past two years were literally "fit only for junk, in workmanship as well as material," and they are made by a well-known and wealthy concern that ought to be ashamed of itself for injuring the reputation of American machine tools for the sake of a few almighty dollars. There are also complaints in regard to machines put out by new concerns that sprang up during the war, but these are due to inexperience, increase of costs, the difficulty of getting good castings and other causes, as well as sheer profiteering. Every American who visits Europe will find instances of this for years to come, which will injure the general reputation of American manufacturers and make buyers there very careful to purchase only reliable makes of tools.

Restrictions on Importations of Machine Tools to France

The present policy of the Comptoir d'Achats de Machines Outils greatly restricts the importation of machine tools into France, and strong efforts are being made to have it discontinued. Under the present restrictions, from three to four months are necessary for the customers' orders to reach

the American manufacturer, and some French dealers have as much as a million francs in orders tied up at the Comptoir. This organization, like some of ours, has outlived its usefulness. It was necessary in war time, but now that the war is over it is only a hindrance to the revival of business and an interference with the import of machine tools into France. Many government and private orders in France have been held up or cancelled on account of the excessive length of time required for delivery—sometimes one year. These delays have been caused not only by restrictions on the receipt of machines in France, but also on account of the American government orders for its war needs, and of the difficulty of securing transportation from America, which sometimes required six months.

Effect of the War on French Machine Industries

The educational effect on the French people of their enormous mechanical development during the war will undoubtedly greatly affect the future of the nation. There will assuredly be a marked advance over pre-war methods, as the French have seen the great advantage of quantity production and also of interchangeable manufacture, and have learned to use high-speed steel as it should be used.

The multitude of little shops throughout France, in which a handful of men turned out machinery, will disappear, to be replaced by manufacturing plants along American lines. Many specialists in other vocations will resume their former work; but the return to France of Alsace and Lorraine with their coal and iron mines and industries, will make that country more of a manufacturing nation than ever before, and she will be an exporting nation in metal goods rather than an importing one, as she was before the war.

Labor and Wages

The labor situation is yet to be worked out; but some results of the war are definitely visible. Some believe that a great many German prisoners will be kept in France for reconstruction work for a certain period, but the number of men and the length of time that they will be retained is to be decided at the peace conference. With this question comes the consideration of work on the railroads, bridges, roads, buildings, etc., all of which have been so neglected that it is a question in many cases of rebuilding rather than repairing.

Wages in France will certainly stay at the present peak for a long time. The cost of living will not go down until enough men have returned to the farms to create more of a competition in prices for foodstuffs, and when that time comes labor may be sufficiently abundant to reduce wages a little; but they certainly will never return to the level of five years ago. This confirms the view which the writer expressed in the December number of MACHINERY, and will reconcile our manufacturers somewhat to similar conditions which exist in this country.

Many women will continue in the mechanical field; but, as in the case of men, those who are specialists, such as dressmakers and milliners, or who are trained in other lines of work that cannot be done by men, will return to their former vocations. Many others are physically unfit for work in factories except on repetition work, and as male labor becomes available will take up lighter work.

Coming Importance of the French Iron and Steel Industry

The basic measure of the iron and steel industry of any nation is its pig-iron production. In 1913, France produced 5,200,000 tons of pig iron, Germany, 19,000,000 tons, and Great Britain, 10,300,000 tons. As at least one-half of Germany's iron producing capacity is likely to be transferred to France by the peace conditions, the pig-iron producing capacity of France after the war will be about 15,000,000 tons, while that of Great Britain will remain about the same as before the war, or around 10,000,000 tons, and that of Germany will also be about 10,000,000 tons. Hence, France is likely to become the largest iron and steel producing nation in Europe, and is likely to have one-half the iron and steel producing capacity of the United States.

In the invaded districts of France there were nearly 26,000 factories and industrial establishments of all kinds, representing more than 30 per cent of the total industrial output of the country. Before the war, this territory furnished 90 per cent of the iron ore, 83 per cent of the pig iron, 75 per cent of the steel, and 70 per cent of the coal of France. It will be some time, of course, before these industries can again be worked at their maximum capacity, and large quantities of American machinery of all kinds will be required in placing them again in operation. The iron and steel industries will require machine tools, especially heavy types.

The Future to which France Looks Forward

French engineers who have been in close touch with the industrial and engineering side of European conditions, all seem to expect that, in the future, France will become the most important industrial country in Europe, even excelling England in this respect. This opinion is based upon the tremendous impetus that has been given to the mechanical industries by the war; the resources in coal and iron within the new boundaries of France; and the necessity for France, as far as possible, not only to supply her own needs in various directions but also to develop her foreign trade, if possible, in order to pay her enormous war debt. The spirit of victory and the assurance of France's future position will have a great deal to do with future development, and another factor of importance will be her ability in future to utilize her entire resources to the best advantage—something she was never able to do before 1870, and less able after that year. It is also believed that France, being depleted in population, will offer considerable opportunity for labor, and that the Italian immigration to the United States will be partly, at least, diverted to France. The proximity of the two nations will make this all the more probable.

In the near future, there will be, of course, a large demand for machine tools in France, but the time will most likely come—and probably within a few years—when the American export trade in machine tools must look for markets in the parts of the world that are as yet undeveloped, but which probably within the next decade or two will become customers—China, Russia, and South America. The opportunities for trade at present in these territories are inconsiderable, but the demand ten years hence may be important. European machine tool manufacturers, as well as makers of other lines of industrial machinery, are already giving close attention to the possibilities in China, where an industrial awakening would mean an enormous opportunity for the trade in machinery.

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FELLOWS GEAR SHAPER CO.'S BONUS SYSTEM

The Fellows Gear Shaper Co., in accordance with the policy decided upon three years ago, has paid an annual bonus to every man and woman who entered the employ of the company before December 1, 1918, and who was still employed on December 24, the date upon which the bonus was distributed. The bonus plan is based upon the yearly earnings of each employe. The minimum rate is 2 per cent of the earnings for those who have been employed one or two years, with 1 per cent added for each succeeding year of employment, up to 10 per cent. For instance, those who entered the employ of the company during 1917 received 2 per cent of their total yearly earnings, and those who entered the employ of the company in 1908 received 10 per cent of their total yearly earnings. The total amount of bonus thus distributed was approximately $14,500. Thirty per cent of the employes of the company have been in its employ for more than three years, and over five per cent, over ten years. Men who have entered the service of the country will, upon their return, receive a bonus based upon their earnings for the time of previous employment, and all employes who entered government service will not be looked upon as new employes.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

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Martell Hand Reamer. Taft-Peirce Mfg. Co., Woonsocket, R. I. 562
Davis Cylinder Boring Machine. Davis & Thompson, 803 Security Bldg., Milwaukee, Wis. 563
Cogsdill Center Drill and Reamer. Cogsdill Mfg. Co., 818-820 W. Warren Ave., Detroit, Mich. 563
Lehmann Taper Attachment. Lehmann Machine Co., 608 S. Broadway, St. Louis, Mo. 563
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Taper Attachment for Sundstrand Manufacturing Lathe. Rockford Tool Co., Harrison Ave. and 11th St., Rockford, Ill. 564
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Superior Oscillating-head Milling Machine. Superior Machine & Engineering Co., 51-53 E. Fort St., Detroit, Mich. 568
Schipper Graduating Attachment for Index-centers. Schipper Machine & Tool Co., Aurora, Ind. 568
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HARRIS IMPROVED AUTOMATIC HOB GRINDER

THE H. E. Harris Engineering Co., Bridgeport, Conn., has recently developed and placed on the market a universal hob grinder known as the Harris improved No. 4 automatic. While this machine is primarily designed for grinding hobs and form cutters, it can also be used for various other grinding operations such as re-gashing worn milling cutters and grinding work of square and hexagonal shape. During the past four years the Harris Engineering Co. has constructed a large number of special automatic hob grinders to meet the varying requirements of different customers, and in placing this new grinder on the market the designers have endeavored to combine all the features and improvements which their experience in building special-purpose grinders has shown to be desirable in machines of this type. In the illustration Fig. 1 the grinder is shown with the cover removed from the spiral and dividing head in order to show the details of construction. The sine bar which generates the spiral section can also be partially observed at the back of the dividing head mechanism. In Fig. 2 the machine is shown with the cover in place over the dividing head.

As its name implies, this universal automatic hob grinding machine is primarily adapted for use in grinding hobs and form cutters; but it will also give satisfactory results in the performance of other grinding operations, among which are included gashing worn milling cutters, grinding square, hexagonal, and other similar shaped work, etc. The machine grinds on both the forward and return strokes of the table, which substantially increases its productive capacity.

The machine grinds both on the forward and return stroke of the table. This feature is made possible by a device which

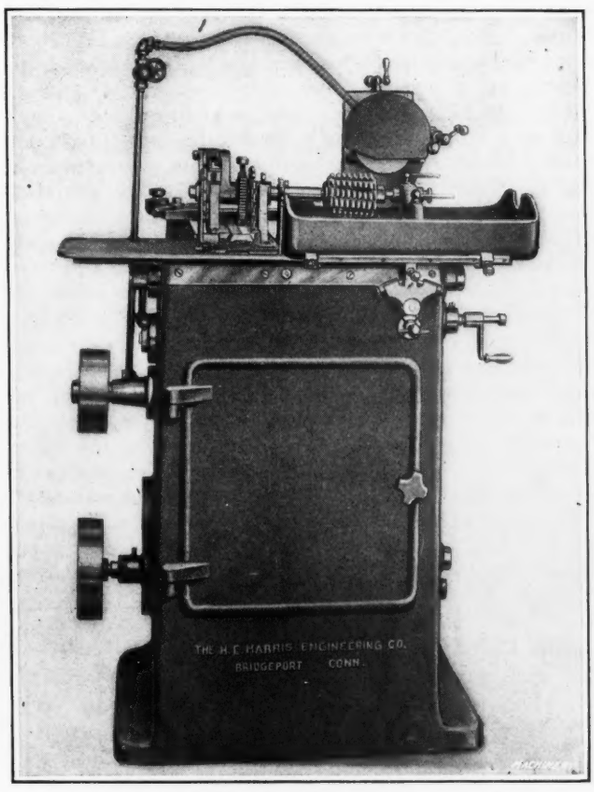


Fig. 1. Harris No. 4 Automatic Hob Grinding Machine with Cover removed from Spiral and Dividing Head

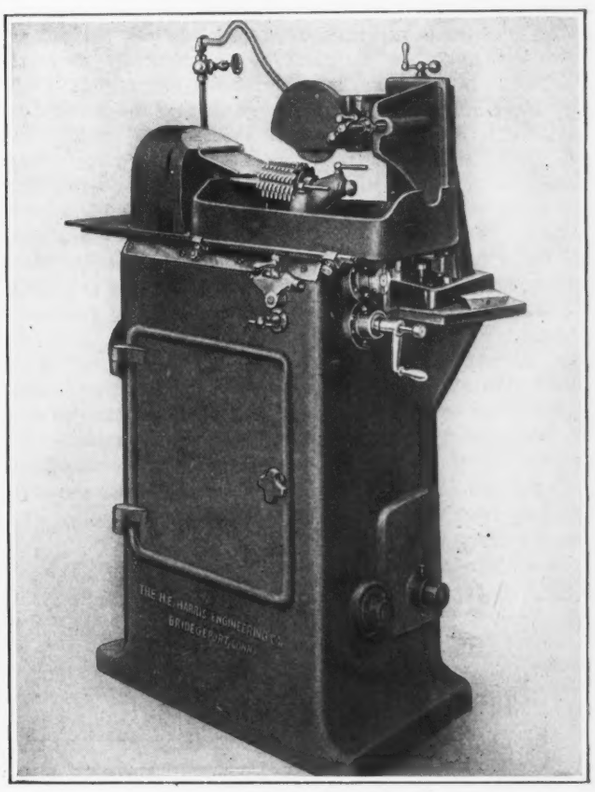


Fig. 2. End View of the Harris No. 4 Automatic Hob Grinding Machine shown in Fig. 1

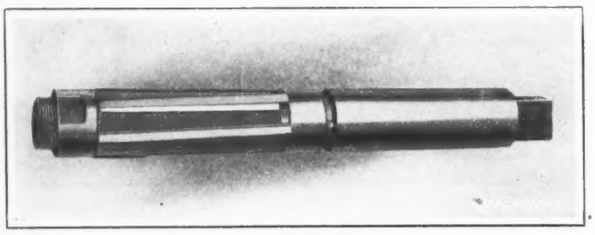


Fig. 1. The Martell Hand Reamer

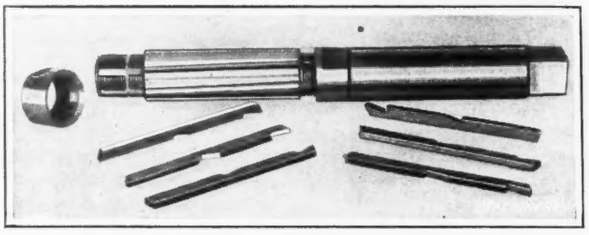


Fig. 2. Hand Reamer disassembled

takes up all the slack on both the forward and return movement of the table. The Harris hob and form cutter grinder is simple in operation, and an inexperienced workman can grind hobs or form cutters as well as the most skilled mechanic. The amount of material ground at each stroke of the machine is uniform when the machine is once adjusted, and the wheel works under flooded lubrication, thus protecting the temper of the hob or form cutter. The feeding mechanism is so designed that the speed at which the work is fed to the grinding wheel is constant.

As the machine is automatic in action and requires only occasional attention, it can be operated by a workman in conjunction with his regular work. The automatic feature proves of great advantage in the salvaging of milling cutters, as the automatic indexing device makes it possible for one operator to attend to several machines. The wheel-spindle is equipped with ball bearings and is mounted on a universal head. Horizontal and vertical movement of the head is obtained by carefully fitted slides. The wheel itself is covered with a guard through which the lubricant is fed by the forced-feed lubrication system. This guard not only safeguards the wheel, but also prevents the scattering of dirt and confines and directs the lubricant to the proper place. After the lubricant has been used, it drains from the work into the pan surrounding the table, which is integral with it, and from there it is fed back into the tank in the column, thus being used over and over. All wearing surfaces are provided with adjustments which are readily accessible so that any play can be taken up simply and effectively. The wearing surfaces are adequately protected from abrasive particles, and provision is made for lubricating these surfaces.

The machine is so designed that all backlash between the work and the wheel is taken up automatically while the machine is in operation, thus preventing any unequal grinding, dragging, or gouging of the wheel into the work. The indexing is done at the end of each double stroke. The wheel-head and its slides, idlers, etc., are held on a large circular mounting at the back of the machine, which allows the wheel to be swung to and clamped at the angle desired, either to the right or left. This movement does not affect the axial position of the wheel in relation to the work-centers, but adapts the wheel to the spiral flutes to be ground.

The spiral mechanism operating directly on the work-arbor is mounted at the back of the machine, where a simple adjustment will give the work-arbor the amount of spiral required. This can be quickly set to a cutter, the spiral of which is not exactly known, by putting the cutter between the centers and trying it out with the table automatic feed thrown out, feeding the table by hand with the handle at the right end of the machine. All necessary adjustments for changing from sharpening one type of hob to another have been carefully worked out.

While the regular type of grinding wheel which is supplied with this machine is primarily designed for grinding the faces of the teeth, it is possible, by means of the transverse adjustment of the wheel-head, to grind the faces of the teeth either radially or with an under-cut or rake, or if desired to grind them more obtuse than a radial tooth would be. The amount of metal removed from the face of the teeth is controlled by rotating the hob a slight amount in relation to the indexing mechanism after each complete revolution. To provide for doing this accurately, an adjusting screw is used. In this manner, if the machine is set for grinding the teeth radially, it will still grind them radially, regardless of the amount which is removed. If the machine is set for grinding the teeth under-cut, it will give the same amount of under-cut when either a small or a large amount is removed from the face of the teeth. A broad-faced wheel is used for grinding squares, hexagons, octagons, etc., or a formed grinding wheel is used to grind special forms. The flutes of a reamer or tap can also be ground by using a special formed wheel. It is also possible to arrange this machine so it will grind the clearance of the teeth of taps at the cutting end. This class of work, however, requires a special attachment.

MARTELL HAND REAMER

An addition has been made by the Taft-Peirce Mfg. Co., Woonsocket, R. I., to the line of Martell reamers manufactured by the company, this addition being a hand reamer shown in its assembled and disassembled state in Figs. 1 and 2, and in section in Fig. 3. As far as the arrangement of the blades is concerned, this reamer is practically of the same construction as the Martell cylinder reamer shown on page 512 of this number of MACHINERY, the only difference being that as the blades here are longer, they are supported at three points instead of two.

By supporting the blade at the center, it is possible to insure proper support of the blade for its whole length, and when expanding or adjusting the reamer, the adjustment will take place properly along the whole face of the blade. The method of adjustment is identical with that for the cylinder reamer. The blades are set at an angle of 1½ degree with the center line, some of the blades being put on a left-hand and some on a right-hand spiral to gain the same advantages as obtained in the cylinder reamer. Fig. 3 shows a sectional view of the reamer indicating clearly how the blades rest upon ground angular supports, by means of which the blades, when forced forward by the adjusting nut, will be raised so as to become adjusted to the larger size required.

The blades are finished in such a way that when under no stress they balance on the middle wedges with approximately 0.003 inch clearance under each end. Drawing up the clamping nuts springs the ends down, seating them on the end wedges and then they are ground in position. By forcing

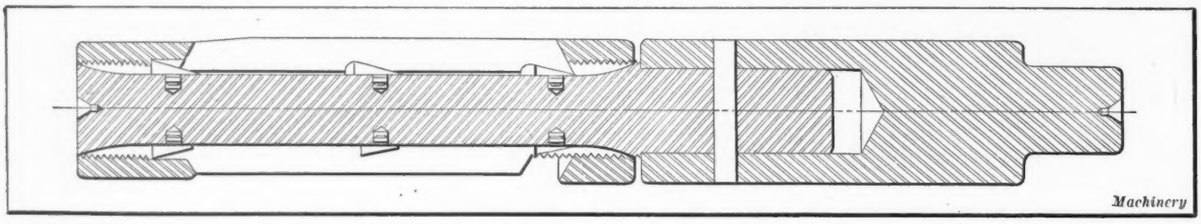
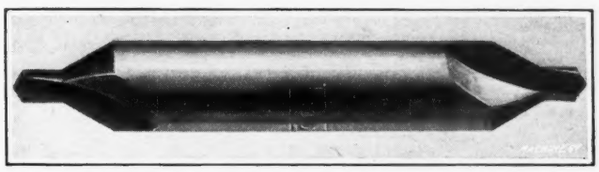


Fig. 3. Design of the Martell Hand Reamer

the blades to bend over the middle wedges, they are held rigidly in place and all tendency to spring outward while cutting is overcome. Blades ground in this way are actually concave when all strain is released by loosening the nuts.

COGSDILL CENTER DRILL AND REAMER

The combination center drill and reamer which is shown in the illustration accompanying the following description is a recent product of the Cogsdill Mfg. Co., 818-820 W. Warren Ave., Detroit, Mich. These drills are made of high-



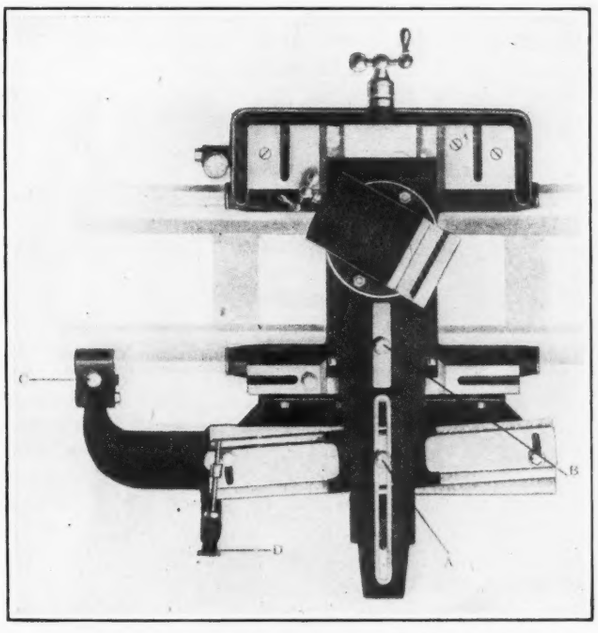
Combination Center Drill and Reamer made by the Cogsdill Mfg. Co.

speed steel, and are provided with radial-relief cutting edges that are produced by a method of grinding on which application has been made for a patent. Deep spiral-fluted chip chutes provide for easily releasing all chips without danger of the tool becoming clogged. These tools are made in twenty different sizes, on which the diameter of the body ranges from 0.302 inch up to ⅝ inch, inclusive. This tool is designed in such a way that it can be recut once for one-third the cost of a new drill.

LEHMANN TAPER ATTACHMENT

A description was published in the July, 1916, number of MACHINERY of a 16-inch engine lathe which was then a new product of the Lehmann Machine Co., 608 S. Broadway, St. Louis, Mo. A taper attachment is not regularly furnished as part of the equipment of the Lehmann lathe, but to provide for the performance of taper-turning operations on these machines, the company is now building an equipment which is here illustrated and described. It is important to note that both the lathe and the taper-turning attachment have been designed in such a way that the attachment can be applied to any lathe after it has been placed in service, very little work being required to do the necessary fitting.

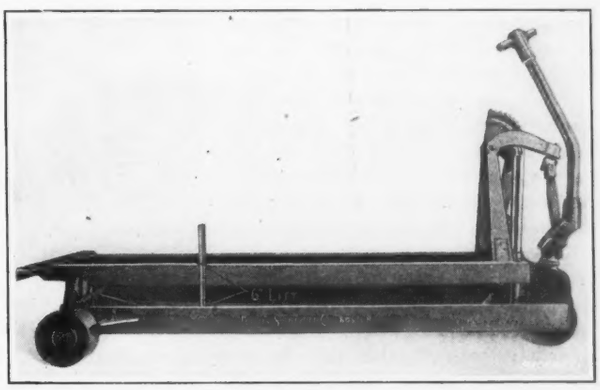
In this attachment, a rigid and direct connection is established between the cross-slide and the taper slide, which avoids straining the cross-feed screw and nut, and also eliminates backlash. The cross-slide extension is gibbed to the carriage, and on top of the cross-slide extension there are two screws, *A* and *B*. When screw *A* is loose and *B* is tight, the cross-feed may be used in the regular way, while to provide for using the taper attachment it is merely necessary to tighten screw *A* and loosen *B*, and to lock clamp *C* on the bed of the lathe. The taper slide is graduated to indicate the degree of taper in inches per foot, and tapers expressed in degrees may also be readily obtained. One full turn of the adjusting handle *D* gives a taper of fifteen minutes from the center line; or in other words, four full turns of the handle provides a setting of the attachment for turning a taper of one degree. Thus, by starting at zero, it is an extremely simple matter to set for any taper desired which is expressed in degrees or minutes.



Taper Attachment developed by the Lehmann Machine Co. for Use on Lathes of its Manufacture

LEWIS-SHEPARD ELEVATING TRUCK

In the January, 1918, number of MACHINERY, reference was made to a Type K elevating truck built by the Lewis-Shepard Co., 48 Binford St., Boston, Mass. The truck was of the "Jacklift" type, built by this company and designed along lines which provided for obtaining an elevation of 3½ inches for the truck platform. Recently, a Type G "Jacklift" truck has been placed on the market, in which provision



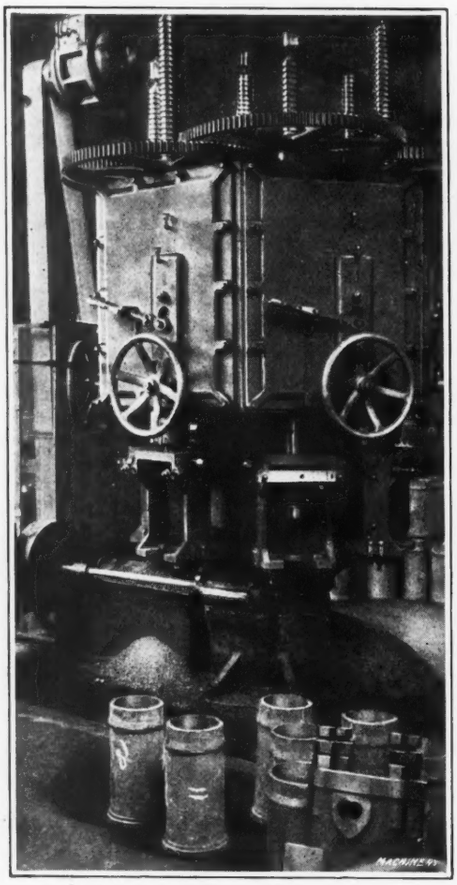
Type G "Jacklift" Elevating Truck built by the Lewis-Shepard Co.

is made for obtaining an elevation of 6 inches. This is an important feature when it is necessary to convey loaded platforms over steep inclines of the general nature frequently encountered in trucking work to and from freight cars, etc. In addition to its high lift, this truck has all of the other features of the trucks of the Lewis-Shepard Co.'s manufacture. It is made in ten different models, five of which have 8-inch wheels and bodies of various lengths, while the other five models have 10-inch wheels.

DAVIS CYLINDER BORING MACHINE

For use in the performance of cylinder boring operations, Davis & Thompson, 803 Security Bldg., Milwaukee, Wis., are now building a continuous rotary cylinder boring machine which is here illustrated and described. In working out the design of this equipment, provision has been made for always having six cylinder blocks set up on the machine. These six pieces of work are carried by the machine head which rotates continuously; and the speed and feed of the six spindles carried by the rotating head are such that after the head has made one revolution, the boring operation in the cylinder block has been completed. In this way, the operator is able to stand at the loading station to remove bored cylinders and substitute rough castings, the remainder of the operation of the machine being automatically controlled. As each casting comes around to the loading station, the operator disengages the feed after which he rapidly raises the boring tool out of the cylinder block. Then it is merely a question of releasing the bolts which

secure the work in the fixture, lifting out the bored cylinder, and substituting a fresh casting. When this has been done the bolts are tightened and the feed clutch re-engaged, ready to feed the boring tool down into the work. With a machine of this kind, where the operation proceeds without interruption, it is obvious that a very satisfactory rate of production can be obtained.



Continuous Cylinder Boring Machine built by Davis & Thompson

FERRACUTE POWER PRESS

In the accompanying illustrations are shown front and rear views of a heavy-duty power press which has recently been placed on the market by the Ferracute Machine Co., Bridgeton, N. J. This is known as a Type S-507 press, and has a capacity for applying pressures up to 500 tons. Tensile stresses in the machine frame are carried by four 5½-inch steel tie-rods that are shrunk into the cast-iron columns. A vertical movement of 18 inches is provided for the ram which makes between 5 and 6 strokes per minute. The available space between the columns is 148 inches and the maximum capacity from the bed to the ram at the top of its stroke and adjustment is 60 inches. Power is supplied through a combination friction clutch and brake by means of which the operator is given complete control of the action, it being possible to start or stop the press in any position; and provision may also be made for running continuously, or for having the ram stop automatically at the top of each stroke. Where motor drive is to be employed, the motor shaft is mounted at the top of the press.

Attention is called to the tapered back-shaft which represents a departure from standard practice in designing. The reason for having this shaft of larger diameter at its driven end is to equalize torsional strains so that both of the large gears will receive an equal tangential pressure upon the teeth. This result is accomplished by having the short part of the shaft twisted to the same degree as the long part. If the shaft were cylindrical for its entire length it would be twisted, of course, far more in the longer section than in the shorter one. As the torsional deflection of a shaft under stress is inversely proportional to the fourth power of its diameter, the proper amount of taper required to produce the desired result may be readily calculated.

A method formerly used to secure equal pressures at the ends of back-shafts was to mount the driven gear at the middle, but this involved the use of a rather unwieldly out-rigger, or bracket, to carry the journal box of the clutch shaft, and required great care in the performance of machining operations while building the press, because it was essential to have the journals of the clutch shaft in accurate alignment. By placing the gear at one end of the shaft and proportioning the shaft according to the amount of stress which each section of the shaft is called upon to carry, it is believed that a more satisfactory design is secured. Where this practice is followed, it is possible to make the clutch shaft shorter.

An idea of the size of the machine shown in the accompanying illustrations, Figs. 1 and 2, will be gathered from the fact that it weighs approximately 137,000 pounds.

TAPER ATTACHMENT FOR SUNDSTRAND MANUFACTURING LATHE

In the May, 1918, number of MACHINERY a description was published of the Sunstrand short-bed manufacturing lathe which had just been placed on the market at that time by the Rockford Tool Co., Harrison Ave. and 11th St., Rockford, Ill. Recently this concern has developed a taper attachment for use on this lathe, and in Fig. 1 one of the machines is shown with the taper attachment in place, while in Fig. 2 the attachment is shown separately in order to give a better idea of its design. It will at once be apparent to

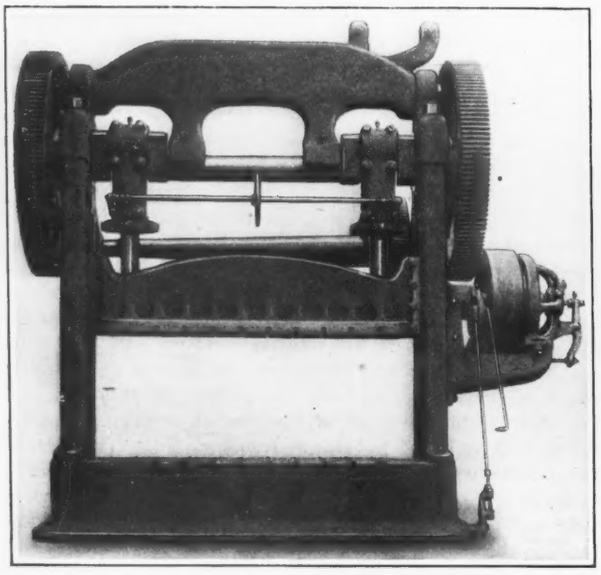


Fig. 1. Type S-507 Power Press built by the Ferracute Machine Co.

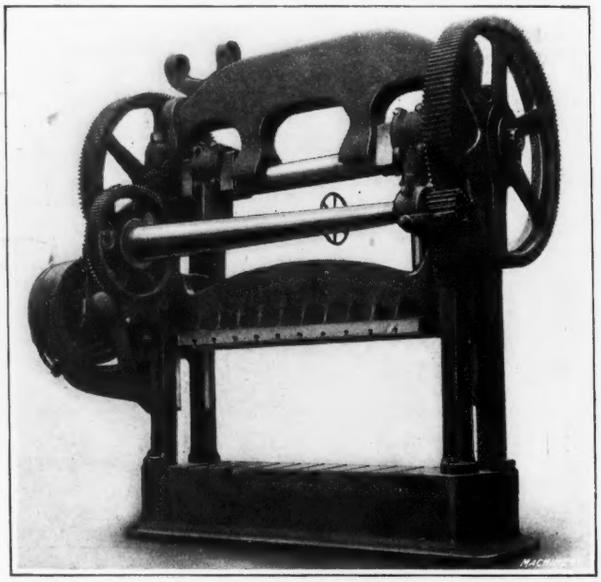


Fig. 2. Opposite Side of the Ferracute Power Press shown in Fig. 1

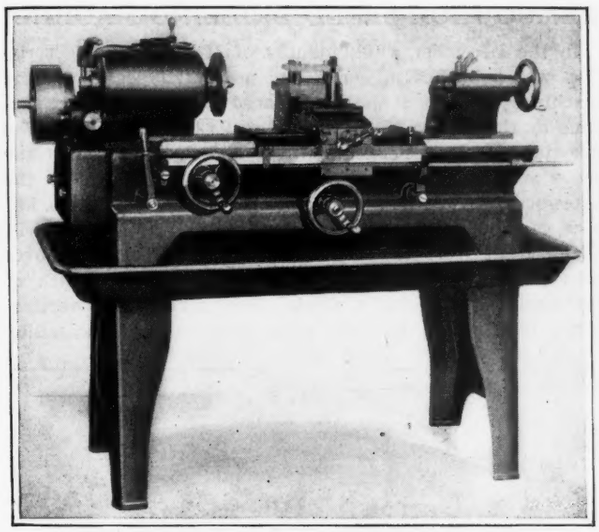


Fig. 1. Sundstrand Manufacturing Lathe built by the Rockford Tool Co. and equipped with the New Taper Attachment

machine designers that a departure has been made from customary practice by placing the taper attachment at the front of the machine instead of at the rear. Another valuable feature is that only three screws are required to hold the attachment in place. Sundstrand lathes are now being built with holes drilled and tapped for the taper attachment; thus, if the user desires to purchase the taper attachment for use on lathes which he has already in his shop, no machine work or fitting is necessary to secure the attachment in place. Two of the screws used for this purpose will be seen on the rectangular block directly beneath the crank which operates the cross-slide feed-screw; and the third screw will be seen on the bracket at the extreme right-hand end of the bed. The attachment is made with graduations to indicate tapers in either degrees or inches per foot, and it is provided with a sliding block running in a bearing which may be set at the desired angle. This arrangement is quite clearly shown in Fig. 2.

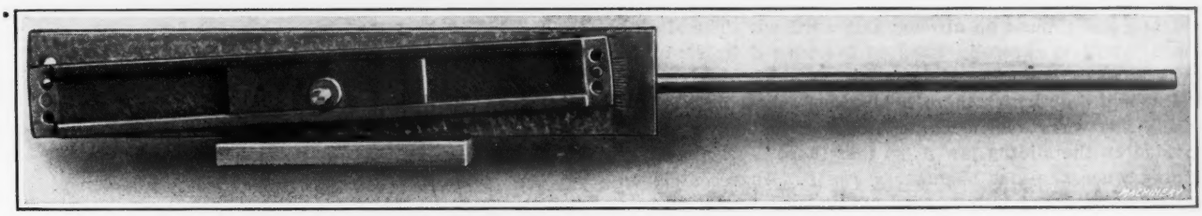


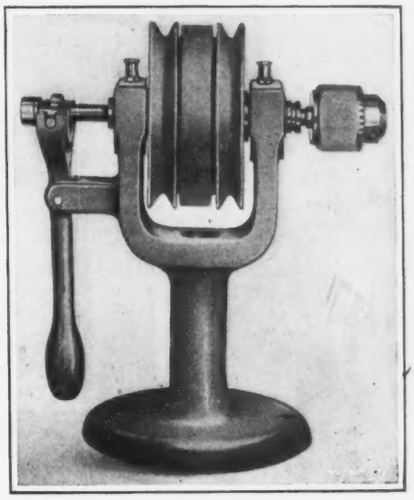
Fig. 2. Taper Attachment shown in Place on the Sundstrand Manufacturing Lathe illustrated in Fig. 1

HARRIS THREAD GAGE LAPPING MACHINE

Owing to the large number of accurate thread gages that have been required in interchangeable manufacturing because of the war and kindred causes, great strides have been made in the facilities for producing them. It is safe to say that only in a very few instances were really accurate thread gages produced prior to 1915. One of the slowest and most difficult operations in making thread gages is that of correctly lapping. To overcome errors in lead and shape of thread, due to hardening and previous operations, it is necessary in doing this work to have a machine which is absolutely under the control of the operator, and which is very sensitive and rapid in operation. The chief difficulties which a thread gage lapper has to contend with are the distortion of the angles of his laps, lapping the gages bell-mouthed, jerkiness in the action of the machine, and last, but not least, inconvenient machines which cause muscle strain. As this lapping is a very sensitive operation, in order to do it right, the operator must be put in the most restful position possible so that his hand can absolutely control the position of the gage while it is being lapped, thus avoiding all tendency to drag the threads or to lap the gage bell-mouthed.

The lapping machine here illustrated and described has an external and internal cone in each one of the driven groove pulleys. Everything is made to be conducive to the comfort of the operator. His left hand and arm rest upon the bench and a slight pressure with either the thumb or index finger of this hand will cause the lapping spindle to drive in either direction. In his right hand, in the case of a female gage, he holds the work while the lap is held in the chuck. His elbow rests on a pad upon the bench, thus taking the weight of his body and leaving the muscles of his hand, fingers, and wrist, completely free for the lapping operation. In the case of a male gage, this is carried by the chuck and the lap is held in the operator's hand. The drive is at high speed, either by a light motor or a high-speed countershaft. The drive is communicated from the groove pulleys by a spider, which is fastened directly to the spindle and carries an external and internal double leather cone friction. The reversing is done so smoothly that it cannot be detected by the eye when the machine is running at high speed; neither is there any shock of reversing.

The reversing mechanism requires a very slight movement, probably one hundredth inch, of the spindle. This is obtained by pressing lightly on the vertically suspended lever with the thumb or finger of the left hand. The upper end of this lever carries a yoke and a ball thrust bearing, so that there is no friction at this point. When there is no pressure with either the thumb or the finger, the ball weight at the end of this shifter lever holds the friction in the neutral position and the lapping spindle at rest. This machine can be run at very high speed for small gages, and can be reversed in a quarter revolution, if so desired. It does admirable work when lapping with emery or carborundum, and is most highly efficient when used with a diamond dust lap. The H. E. Harris Engineering Co., Bridgeport, Conn., originally built these machines for its own thread gage department, in which twenty-four were used; but owing to the demands from other thread gage makers, they have been put on the market. The capacity is from the smallest thread gage which is made, up to 3 or 4 inches in diameter. The H. E. Harris Engineering Co., in its thread gage department, has obtained remarkably good results from inexperienced women after a few days' schooling on lapping by using these machines.



Thread Gage Lapping Machine built by the H. E. Harris Engineering Co. for lapping Either Male or Female Thread Gages

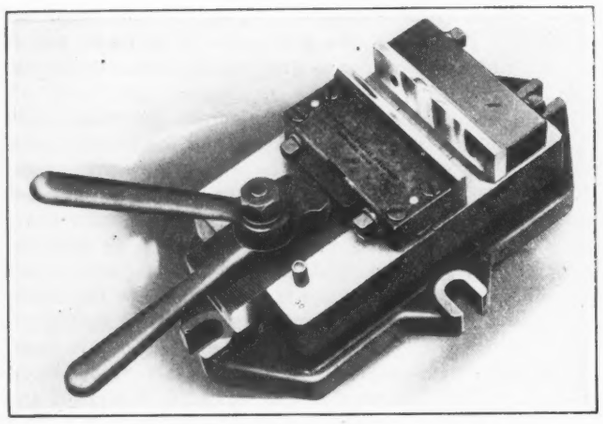


Fig. 1. Milling Vise manufactured by the Hartford Special Machinery Co.

HARTFORD MILLING VISE

The 5-inch quick-acting milling vise which is shown in Fig. 1 is one of the recent products of the Hartford Special Machinery Co., Hartford, Conn. Parts of this vise are shown in Fig. 2, and by referring to this illustration in connection with the assembly view, a good idea will be obtained of the features of this tool. Referring to the latter illustration, attention is called to the fact that parts *A*, *E*, and *F* are made from drop-forgings of alloy steel, while parts *K*, *D*, *H*, *J*, and *L* are made from bar stock, machined all over, and fitted to gages, so that all parts of the vise are interchangeable. With the exception of base *B* which is machined from a gray iron casting, all parts of the vise are made of steel, hardened and ground on all engaging surfaces. The sliding T-head jaw *A* is carefully fitted to the base *B* by scraping. There is a T-slot in the sliding jaw *A* which receives the head of bolt *J* on which there is provided a bearing *H*. This bearing has serrations machined in it which engage those provided on the sliding jaw *A*, so that there is no danger of slipping when the vise is under a strain. An eccentric binder-handle *F* fits into cam-handle *E*, and both swing on bearing *H* which is clamped to jaw *A* by means of bolt *J*. In operation, the sliding jaw is adjusted to the work by clamping the bearing in its proper position. Cam *E* moves the jaw up to the work and partially clamps it, after which a movement of the eccentric *F* affords the final grip.

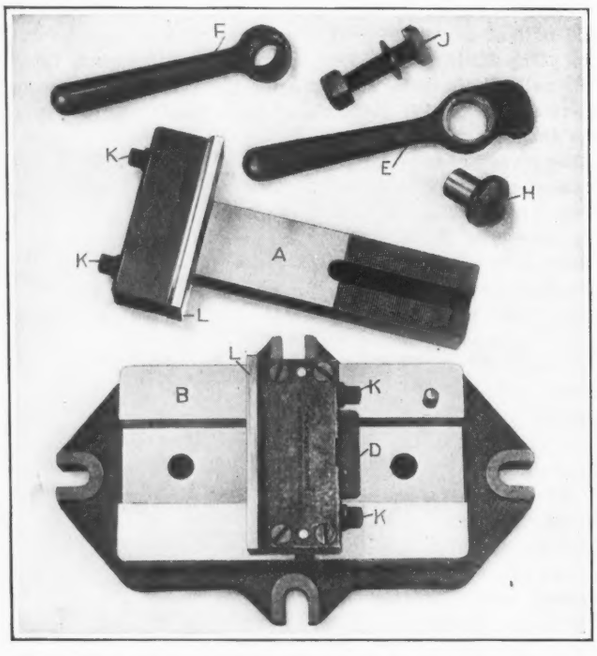
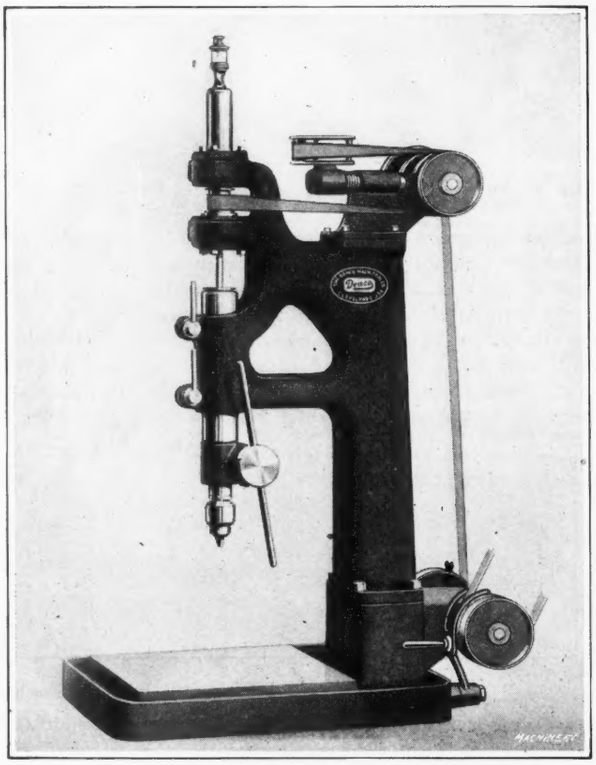


Fig. 2. Parts of the Hartford Milling Vise which is shown assembled in Fig. 1

DEMCO HIGH-SPEED DRILLING MACHINE

In the December, 1917, number of MACHINERY, a description was published of bench and pedestal types of drilling machines which had just been placed on the market at that time by the Demco Machine Tool Co., Cleveland, Ohio. The machine which is here illustrated and described is of the same general design as those previously illustrated, the noteworthy improvement consisting of a change which has been made in the method of driving the spindle. It will be apparent from the illustration that the belt runs over idler pulleys carried by a horizontal shaft at the back of the machine, and over a single idler carried by a vertical shaft, from which the belt runs down to the cone pulley



Improved Design of Bench Type of Drilling Machine built by the Demco Machine Tool Co.

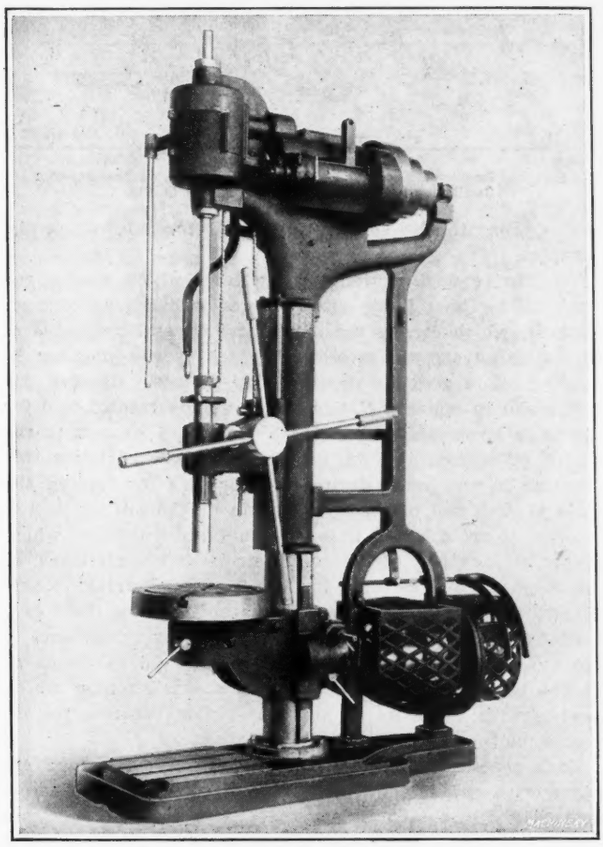
located at the base. It will be seen that the idler pulley carried by the vertical shaft, or stud, is mounted on a bracket, the position of which may be adjusted by means of a screw. In this way, it is an easy matter to so adjust the belt tension that efficient conditions of operation may always be maintained. Other features of the design of this improved drilling machine are essentially the same as those of the preceding type of machines which have already been described. In addition to the bench type of machine shown in the accompanying illustration, a pedestal type of drilling machine of this design has also been placed on the market.

WEIGEL VERTICAL DRILLING MACHINE

A 21-inch vertical drilling machine, equipped with back-gears, a tapping attachment, and a plain quick-return, is a recent product of the Weigel Machine Tool Co., Peru, Ind. In working out the design of this machine, the standard friction quick-return and power feed mechanism have been eliminated and the plain quick-return mechanism has been substituted. The quick-return shaft carries four long levers mounted in the form of a pilot wheel, which afford a powerful hand feed. This machine is also built without the tapping attachment or back-gears. When the back-gears are not included, a friction drive is provided for starting the machine, and a brake for stopping it instantly. A control lever for starting or stopping is located at the front of the

machine in the same position as the back-gear lever. Twenty-five-inch machines of the same general design as the 21-inch tools, which have just been described, are built by the Weigel Machine Tool Co.

The principal dimensions of the machine are as follows: Total height with spindle extended, 9 feet, 6½ inches; height to top of drill, 7 feet, 6½ inches; distance from base to spindle, 46½ inches; distance from table to spindle, 30½ inches; capacity, for drilling to center of a 21⅝-inch circle; traverse of table on column, 13½ inches; traverse of head on column, 21 inches; traverse of spindle 9 inches; diameter of table, 19 inches; diameter of column, 7 inches;



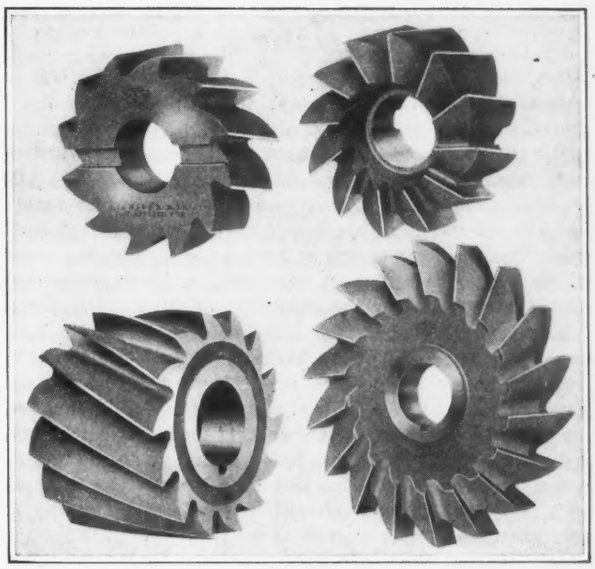
Back-geared 21-inch Drilling Machine built by the Weigel Machine Tool Co.

diameter of spindle above sleeve, 1 9/16 inch; diameter of spindle in sleeve, 1 11/16 inch; diameter of sleeve, 2⅝ inches; bore of spindle, No. 4 Morse; and ratio of back-gears, 6.44 to 1.

"GO & GO" MILLING CUTTERS

The Goddard & Goddard Co., 39 W. Congress St., Detroit, Mich., has recently added to its line of "Go & Go" milling cutters a line of tools which are made with teeth of the form shown in the accompanying illustration. It will at once be seen that the distinctive feature of this design is the way in which the metal is carried up behind the back of the teeth in a curve, which affords an unusually favorable condition for supporting the teeth directly behind the cutting edges. The reason for this is apparent, because if a straight line is employed, the angle must be such that the required amount of strength is obtained, and then it is sometimes difficult to combine with this strength the required amount of chip clearance between the teeth.

It is claimed for these cutters that the following advantageous conditions of operation are obtained: Owing to the liberal amount of support for the teeth which is provided directly behind the cutting edge, it is entirely feasible to provide a 10-degree end cut which increases the cutting efficiency. Ample strength for the cutting teeth is combined

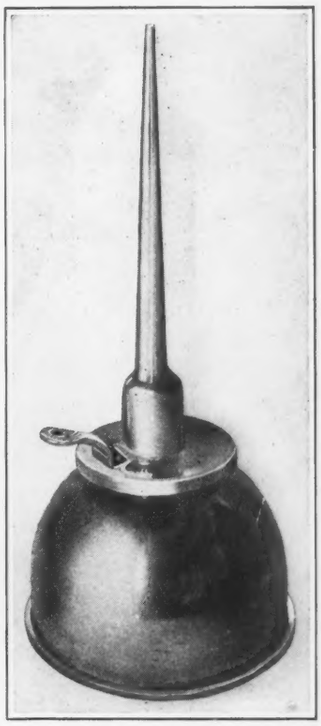


"Go & Go" Cutters with Improved Type of Teeth recently developed by the Goddard & Goddard Co.

with a liberal amount of chip clearance. Another feature which is not directly connected with the form of the back of the teeth, but which is highly important in determining the efficiency of the teeth, is that in the case of shell end-mills, plain milling cutters, etc., the cutting edge is made to conform to a sufficiently steep spiral angle so that a shearing action is obtained.

LIDSEEN FORCED-FEED OILER

Gustave Lidseen, 224-230 N. Desplaines St., Chicago, Ill., is now manufacturing a line of positive forced-feed oilers, one of which is shown in the accompanying illustration. The chief point of difference between this oiler and the commonly used form of oil-can is that the Lidseen oiler has a solid bottom and special means for forcing oil through the spout of the can into the bearing which is to be lubricated. This result is accomplished by means of a trigger located at the base of the spout which actuates a plunger working in a cylinder located between the can and the spout. When the trigger is pushed down it moves the plunger in this cylinder and forces oil through the spout of the can into the bearing. No reliance is placed upon a spring bottom in the can to accomplish the same result. Another noteworthy feature of the design of the Lidseen oiler is that the spout is held onto the can by means of curved flanges; and a packing is furnished between the base of the spout and top of the can in order to insure maintaining an oil-tight fit. These cans are made of drawn steel, and they may be furnished either copper-plated or with a gun metal finish. They are made with 5½- and 9½-inch spouts and with capacities for ½ and ¾ pint, respectively.



Forced-feed Oiler manufactured by Gustave Lidseen

SUPERIOR OSCILLATING-HEAD MILLING MACHINE

For use in the performance of slot milling operations in screw heads and similar work, the Superior Machine & Engineering Co., 51-53 E. Fort St., Detroit, Mich., has placed on the market an oscillating-head milling machine which is here illustrated and described. This equipment provides for milling slots with a two-lipped milling cutter by revolving the cutter at high speed, and oscillating it at the same time. The diameter of the cutter corresponds to the width of the slot to be milled in the work, while the length of the slot is governed by the oscillation of the spindle, which, in turn, is regulated by the detachable block carried by a crank disk at the rear of the machine. This disk is driven by a flanged pulley from which power is transmitted through gearing that runs in a bath of oil and is entirely enclosed. The fixture which carries the work is fastened to the table so that the work may be automatically fed up to the milling cutter; and when the slot has been cut to the required depth, the feed is automatically tripped. A T-slot in the table affords a simple method of securing the work-holding fixture in place.

A split chuck holds the milling cutter in the machine spindle, this chuck being of the draw-in type and backed up by a threaded rod which passes through the hollow spindle. This rod prevents any possibility of the milling cutter sliding backward, and at the same time acts as a guide in replacing the cutter after it has been removed for sharpening. An adjustment of the degree of oscillation, and consequently of the length of slot milled in the work, is secured by changing the position of the pin carried by the crank disk. It is also possible to adjust the spindle head on the oscillating table, and clamp it in the desired position, by means of four bolts entering T-slots. The machine spindle is hardened, ground, and lapped, and runs in bronze bearings which are provided with means of compensating for wear. Reservoirs

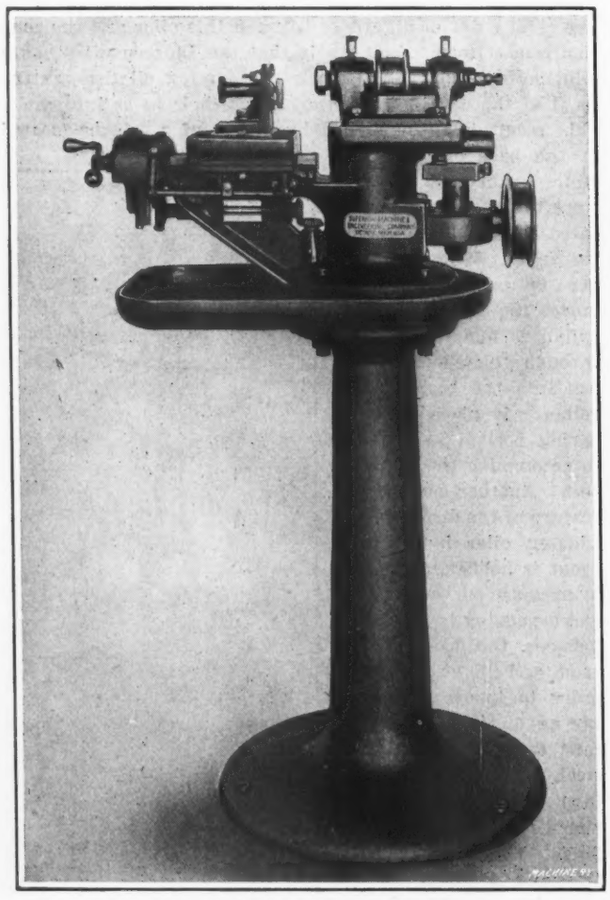


Fig. 1. Improved Type of Oscillating-head Milling Machine built by the Superior Machine & Engineering Co.

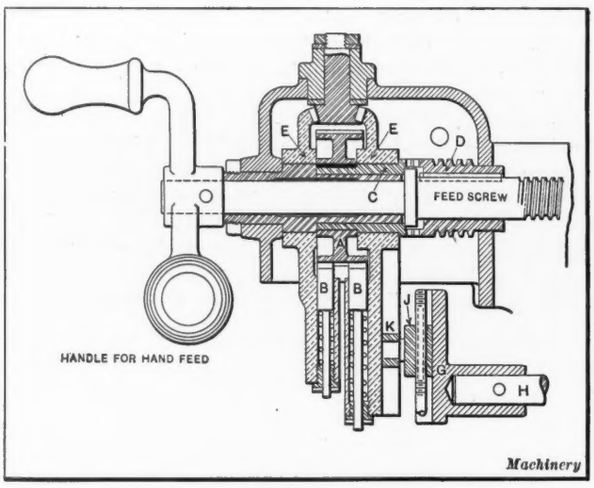


Fig. 2. Improved Type of Feed Mechanism used on the Superior Oscillating-head Milling Machine shown in Fig. 1

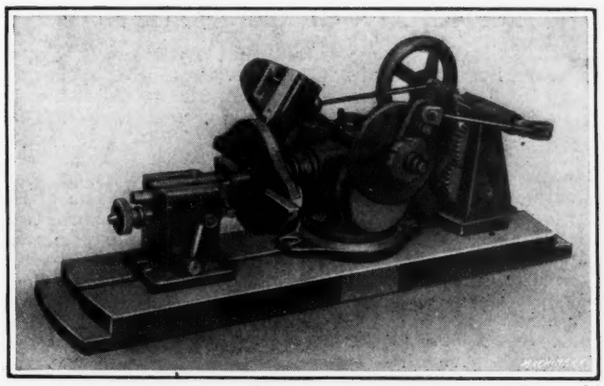
located beneath the spindle supply oil for lubricating the bearings.

To provide feed motion for the table which carries the work up to the milling cutter, power is delivered through shaft *H*, which carries the crank arm *G*; and by means of an adjusting screw, the slide *J* which carries member *K*, may be set to give the required rate of feed. Block *K* fits into a slot in segment *E*, and the maximum rate of feed for the table is obtained whenever *K* is located nearest to the center of segment *E*. In working out the design for this machine it was found desirable to provide for feeding the table at each end of the stroke made by the milling cutter, in order to avoid loss of time; and this feed movement which occurs at each end of the cutter stroke is accomplished by the mechanism illustrated in Fig. 2. By referring to this illustration, it will be seen that in the feed-case there is a stationary sleeve on which the clutch *C* and segments *E* are mounted. The ratchet wheel *A* is keyed to clutch *C*. In the top of the feed-case there is a small pinion which meshes with segments *E*, and this pinion reverses the direction of the segments when oscillating.

Each segment *E* carries a spring plunger *B* which engages with the ratchet wheel *A* and turns the feed-screw at each end of the cutter stroke. Clutch *D* is slidably connected to the feed-screw and is engaged with clutch *C* when the table is being automatically fed by power. Clutch *D* may be disengaged by hand at any time the operator desires to do so, and it can also be disengaged automatically at any time by means of a rod on the side of the machine, which carries an adjustable stop. This arrangement allows the feed-screw to be turned by hand in either direction after clutch *D* has been disengaged, without revolving the ratchet wheel; and consequently, unnecessary wear of the ratchet wheel and plungers is prevented. These machines can be set in a pan on a bench, or several machines can be set up on one table according to the requirements of the shop in which they are to be used. They are so designed that provision is made for milling slots of any width up to 3/8 inch by 2½ inches in length. The weight of the machine is approximately 400 pounds.

SCHIPPER GRADUATING ATTACHMENT FOR INDEX-CENTERS

In the October, 1918, number of MACHINERY a description was published of the 10-inch universal index-centers which had just been placed on the market at that time by the Schipper Machine & Tool Co., Aurora, Ind. Recently this company has developed an interesting attachment for use on these centers. The object of this attachment is to provide for graduating or marking tools at any angle from 45 to 90 degrees, inclusive, and around the entire circumference of



Graduating Attachment for Use with Index-centers made by the Schipper Machine & Tool Co.

the dials for use on feed-screws of machine tools, etc. The index-centers will swing work up to 10 inches in diameter, and provision is made for cutting four short graduation lines and one longer line, this order being repeated indefinitely. The index-centers with the graduating attachment can be set up on any flat surface, such as a milling machine table, planer bed, or work-bench. The outfit is of compact design, weighing only 110 pounds, and is said to be capable of operating rapidly and producing entirely satisfactory results in the performance of those graduating operations which come within its range.

QUICK-MAKE STARTING SWITCH

One of the new equipments brought out by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., during the past year, is an interesting starting switch. The switch is designed for use where squirrel-cage motors are started with a full line voltage. It is known as the quick-make (and quick-break) starting switch, and its characteristics are 10 to 100 amperes, 25 horsepower maximum, three-phase, 220, 440, and 550 volts. The switch is extremely flexible in its applications; in addition to being a motor starting switch, it can also be used to control feeder circuits; and it may be supplied in any of the following combinations, each having the "quick-make and quick-break" feature for either hand or shipper-rod operation: (a) non-automatic switch; (b) switch with low-voltage protection; (c) switch with inverse time element overload protection; and (d) full automatic switch with low-voltage and inverse time element overload protection. This switch is especially suitable for operation by means of a shipper-rod on account of the positive action of the contacts. It is not possible for the operator to retard the motion of the contacts after they have started to close; and there can be no "teasing" of the contacts. Workmen who are accustomed to starting machines from lineshafting by means of shifting belts have no confusing details to learn. They may start the motor-driven machine with the same starting motion they use in shifting belts.

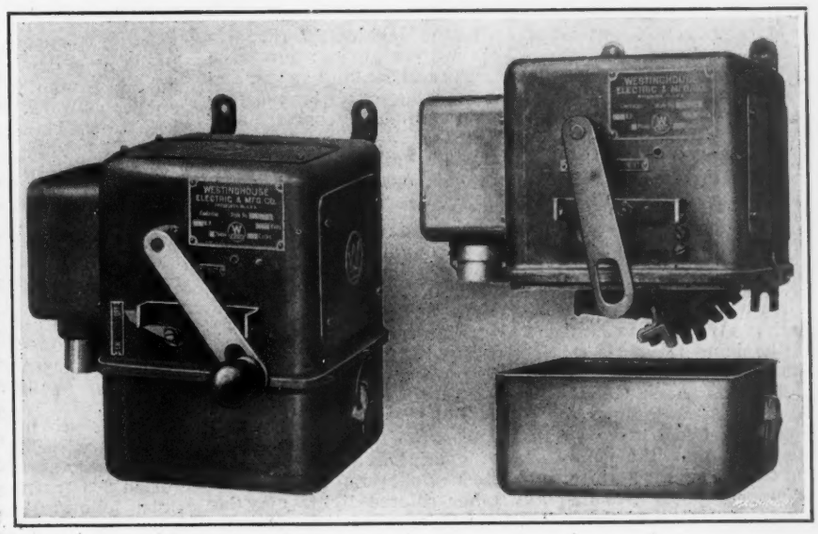
The contacts are opened and closed in oil, thus effectually suppressing arcing. The contact is made or broken so quickly that the eye cannot follow the motion, and a rolling action confines the arc to the tips of the contacts and prevents pitting or roughening of the seating parts where final contact is made. A strong spring holds the contacts firmly in the closed position. These features result in greatly prolonged life for the contacts. A drawn-steel construction is used giving maximum strength with light weight, and assuring uniformity and interchangeability when new parts are needed for replacement or repairs. The oil tank is supported by snap ring latches, and removal of the tank clearly exposes the contacts and makes them easily accessible, When it becomes necessary to replace contacts, each may be removed by taking out a single screw. These contacts and contact supports are of the same construction as is used for Westinghouse Type A auto-starters and magnetic contactors, which minimizes the number of spare parts that should be carried. These starting switches are dustproof; openings are provided for conduit wiring in the top of the case; and the terminals for connecting the motor and line wires are accessible when the cover at the top of the starter is removed. Micarta insulation is used throughout. Overload and low-voltage attachments may be added with no change in the switch mechanism as the toggle trip is common to all combinations of this switch.

Low-voltage protection not only opens the contacts on the failure of the power, but makes it impossible to close them again until return of the voltage. Since the low-voltage coil is connected in the line circuit continuously, means have been provided to close the armature of the low-voltage circuit when the switch is in the "off" position, thereby giving protection to the coil and preventing burn-outs. A safety stop may be provided by connecting one or more push-buttons in series with the low-voltage coil.

The overload relay is the same as that used on Westinghouse Type A auto-starters. It has the inverse time element feature, and is equipped with a regulating device, adjustment of which controls the degree and duration of the overload possible on a motor or feeder circuit. This adjustment can be made without opening the switch cover. The hand reset is an additional safety feature which makes it necessary to set the mechanism before the switch contacts can be closed. Whether the contacts have been opened through the operation of the low-voltage coil, the overload relay, or by moving the switch handle to the "off" position, it is impossible to close them again until the switch handle has been moved to the "reset" position. Thus protection is afforded both to the workmen and to valuable machinery which might be injured by accidental starting of the motor.

* * *

An employment office on wheels, mounted on a Packard truck, is an innovation introduced by the Packard Motor Car Co. The mobile office is furnished with benches, each of which has accommodation for four or five applicants and a desk for the company's employment representative. The applicant enters by a short stairway which is let down from the rear. In cold weather this completely equipped room is heated by a hot water heating plant, which operates directly from the water circulating system of the engine.



"Quick-make" Starting Switch made by the Westinghouse Electric & Mfg. Co., shown with the Case Open and Closed

NEW MACHINERY AND TOOLS NOTES

Tool Marking Outfit: J. M. Waterston, 77 Woodward Ave., Detroit, Mich. This outfit consists of a steel scriber, three bottles containing varnish, etching fluid and cleaning fluid, respectively, a brush and full directions for marking tools.

Thread Grinding Attachment: American Standard Gage Corporation, 7-8 Chatham Sq., New York City. A portable thread grinding attachment which is adapted for use on any lathe by clamping to the compound rest. When the attachment is not required it can be removed from the lathe and stored away.

Compression Coupling: C. H. Clark, 60 Grand St., New York City. A coupling which consists of three cylindrical segments laid against the shaft, and two rings. The outside of the three pieces forming the main body of the coupling is slightly tapered and the rings are driven on from the ends, affording sufficient compression to hold the two ends of the shaft firmly together.

Crank Shaper: Sellew Machine Tool Co., Pawtucket, R. I. A 16-inch belt-driven crank shaping machine which is especially adapted for tool-room work, although it has been made sufficiently heavy and rigid for use in the performance of general manufacturing operations. Motion of the ram is obtained by the use of a crank. Adjustments with degree and micrometer readings enable angular work to be easily handled on this shaper.

Portable Electric Drill: Black & Decker Mfg. Co., 10 Guilford Ave., Baltimore, Md. This company has added to its line of portable drilling tools a 7/8-inch drill which weighs approximately 27 pounds. It is equipped with a removable No. 2 Morse taper socket to take a taper shank up to 7/8 inch diameter. The drill measures 5 3/4 by 17 inches and has an off-set spindle which is located 2 3/8 inches from the edge of the frame.

Sine Bar Attachment: Presto Machine Works, 124 Pearl St., Brooklyn, N. Y. The sine bar itself is 4 inches in length and the attachment is accurately finished to a 4-inch cube, all faces of which are provided with a number of tapped and countersunk holes to provide for attachment of work, clamps, etc. Five sides of the cube are provided with accurate V-grooves for seating cylindrical work and one side has a T-slot quadrant for attaching the sine bar.

Adjustable Electric Light Bracket: K. F. M. Lindblad, 65 Sudbury St., Boston, Mass. A jointed electric light bracket which is particularly adaptable for use in shops where it is necessary to get the required adjustment of electric lights for the purpose of efficiently illuminating the work. The present arrangement consists of a bracket made of jointed sections which may be adjusted as desired to provide for locating the light in exactly the desired position.

Lathe Chucks: Terkelsen & Wennberg, 326 A St., Boston, Mass. A line of lathe chucks which have the body made of a heavy single-piece construction and ground to a finish. The back of the body is not slotted and it is claimed that this gives additional strength. Thrust bearings are provided at the end of each screw and the jaws are double gibbed. Use of heat-treated 0.30 to 0.35 per cent carbon steel for the jaws affords ample strength, and the jaws are ground all over and made interchangeable.

Motor-driven Countershaft: Presto Machine Works, 124 Pearl St., Brooklyn, N. Y. This equipment was developed in connection with the company's work of making gages, and received a thorough test under working conditions before it was placed on the market. The equipment consists of a heavy cast-iron base provided with a bracket to support a motor of 1/4 or 1/2 horsepower. The motor is of a type suitable for plugging directly into an electric lighting circuit. The whole outfit weighs only 75 pounds.

Signaling Pyrometer: Brown Instrument Co., Philadelphia, Pa. An automatically operated indicating pyrometer which is connected to a thermo-couple in the furnace and three signal lights located at the furnace. An electric motor mounted beneath the pyrometer instrument causes the signaling apparatus to be operated at intervals of ten seconds. If the temperature is O. K., a white light is flashed at the furnace, while if the temperature is low, a green light shows, and a red light is flashed in case the temperature is too high. In case of too high or too low a temperature, the light denoting that fact calls the attention of the furnace attendant who regulates the conditions of operation as may be required. The red, white, and green lights referred to are commonly used, although any other colored lights may be employed. One of these instruments may be connected to the thermo-couple and signal lights provided at any number of furnaces up to and including twelve.

MATERIALS OF CONSTRUCTION

JOHNSON'S MATERIALS OF CONSTRUCTION. By M. O. Withey and James Aston. Edited by F. E. Turneaure. 840 pages, 6 by 9 inches. Numerous illustrations. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $6.

This is the fifth entirely rewritten edition of the well-known work "Materials of Construction," published some twenty years ago, by Dean J. B. Johnson. It is one of the largest and most complete works published on materials of construction, dealing with metals as well as with non-metal building materials. The great scope of the work is best indicated by a review of the contents of the twenty-nine chapters into which it is divided, which are headed as follows: Synopsis of the Principles of Mechanics of Materials; Machines and Appliances for Mechanical Tests; The Mechanical Testing of Structural Materials; Characteristics, Physical Properties, and Uses of Wood; The Deterioration and Preservation of Timber; The Mechanical Properties of Timber; Building Stone; Structural Clay Products; Portland Cement; Natural and Other Hydraulic Cements; Limes and Plasters; Methods of Testing Hydraulic Cements; Making Mortar and Concrete; The Physical Properties of Mortar and Concrete; Portland Cement Products; Metals and Their Ores; Reduction of Iron from its Ores; Manufacture of Wrought Iron and Steel; The Manufacture of Iron and Steel Shapes; Formation and Structure of Alloys; Constitution of Iron and Steel; Properties of Wrought Iron; Properties of Steel; Alloy Steels; Cast Iron and Malleable Cast Iron; Non-ferrous Metals and Alloys; The Effect of Temperature on the Mechanical Properties of Metals; Fatigue of Metals; and Corrosion of Metals.

In arrangement, the new book differs markedly from the earlier editions which were somewhat cumbersome in this respect. The division into parts has been discarded, and related subject matter has been more closely coordinated. On the whole, therefore, the arrangement is much more logical, and reference to specific subjects is made easier. A complete index is also provided so that incidental reference to materials that are not treated in all their aspects under a given chapter heading may be easily found. Great care has been taken to illustrate the revised work adequately. Old illustrations have been redrawn and diagrams and charts have been largely used for presenting facts and laws. Tables have been omitted wherever possible, charts being used in their stead. There have also been some changes in the scope of the new work; the space devoted to the principles of mechanics has been materially reduced by more concise treatment, a departure which is justified by the fact that these principles are now well treated in many text-books on mechanics and structural design. The methods of microscopic analysis and magnetic testing of materials have been omitted, since it was believed by the revisers that an adequate treatment of these very important methods of investigation cannot be given in a treatise of this nature. On the other hand, the new work treats more fully than the older editions of non-metallic materials, as well as of the methods of manufacture of metals, the structural constitution of metals and alloys, the corrosion and protection of metals, and the decay and preservation of timber.

In preparing the work, care was taken to properly subordinate theoretical and practical considerations, and hence the cooperation of Professor Withey, assistant professor of mechanics at the University of Wisconsin, and Mr. Aston, metallurgist with the A. M. Byers Co., of Pittsburg, proved highly valuable. Dean Turneaure of the College of Engineering, University of Wisconsin, has endeavored, as editor, to adhere to the purpose which inspired the first edition of Johnson's work, so as to preserve it as a work of real service both to students and to practical engineers.

* * *

The extensive areas of agricultural land in Latin-American countries offer a rich field for the development of trade in farm tractors. Many of the estates in these countries comprising hundreds of thousands of acres still cultivate their crops of grain, sugar, and cotton, under the old systems that require large numbers of laborers and horses. Where trucks have been used on these extensive plantations, they invariably show an economy of time and expense, and the increasing shipments of tractors to these districts indicates that the more progressive ranch owners realize the value of new methods. The lack of transportation facilities is acutely felt in some of the richer sections of South America, and the tractor is proving of incalculable advantage in the construction of needed highways. Mexico leads all other Latin-American countries in the importation of tractors, having imported 285 tractors from the United States in the year 1918. Cuba follows Mexico, having imported 165 tractors in the same year. Panama leads the Central American countries with an importation of 16 tractors and Brazil leads in South America with an importation of 83.

PROMOTION OF THE BRITISH PRECISION TOOL INDUSTRY

The British Ministry of Reconstruction is at work on the task of making Great Britain a self-supplying nation in a number of highly important commodities which have in the past been procured either wholly or partly from abroad. To deal with this problem more effectively, the department has been subdivided into numerous sections, each dealing with some particular article or group of allied articles under the direction of an expert. One subject that is engaging attention at present is that of engineers' fine tools, which includes the various precision tools used in engineering work, particularly instruments and gages used for measuring accurately to 0.0001 inch. These have in the past come mainly from the United States and to a lesser extent from Germany and France. The value of the imports of these goods has reached several hundred thousand pounds a year and as regards the majority of them, it is found that no serious attempt has yet been made to produce them in Great Britain.

It is the object of the department to promote the home manufacture of as many of these tools as possible by those companies already making gages of various kinds. Some people doubt the ability of Great Britain to supply this class of goods on a competitive basis, as they say that among other things England lacks a supply of young mechanics who are thoroughly trained and who are capable of producing work of the fine degree of accuracy required in making this class of tools. It is also said that it would be necessary to have large plants which could not be kept in operation unless a world-wide trade was established. It is encouraging to note that very fine work in the making of screw gages is being accomplished on quite a large scale in the Engineering Department of the Sheffield University. M. E.

* * *

RADIAL SHAPER ATTACHMENT

An unusual shaper operation is illustrated in Fig. 1, which shows a shaper equipped with an attachment or fixture for planing a radial T-slot in a bronze rocker-arm. Two of these rocker-arms may be seen on the table at the right-hand side of the illustration. The T-slot extends clear through that part which is attached to the end of the arm or lever. The detail view, Fig. 2, shows clearly the general arrangement of the attachment and the method of holding the rocker-arm in position. The arm *A* is clamped in V-blocks, and plugs *B* enter each end of a hole which has been previously drilled at this end of the casting. The tool-head is equipped with two slides which are operated by the handwheels *C* and *D*, for obtaining vertical and horizontal adjustments. This tool-head has a pivot or bearing at the upper end, and it is given a swinging movement when the machine is in operation. This swiveling motion is derived from the ram of the shaper by means of a link clamped in the toolpost and connecting with an arm on the rear side of the fixture. The cutters are set to gages both for height and width, these gages bearing on steel pads at the bottom and side of the fixture. After the tool is set by means of the gages, stops are adjusted for controlling the vertical and lateral feeding movements within the limits required, so that the tool can be worked anywhere between these stops. There are four tools, two for roughing and finishing the main slots, and a right- and a left-hand tool for the T-slot. With this attachment, a slot 1 inch wide, ⅞ inch deep, 8 inches long, with a $\frac{3}{16}$- by ¼-inch T or under-cut on each side at the bottom, is finished every five hours. The radius of the T-slot is 10¾ inches and it is made to fit the segment of a worm-wheel. This radial attachment is a design of the Gem City Machine Co., 434 E. First St., Dayton, Ohio.

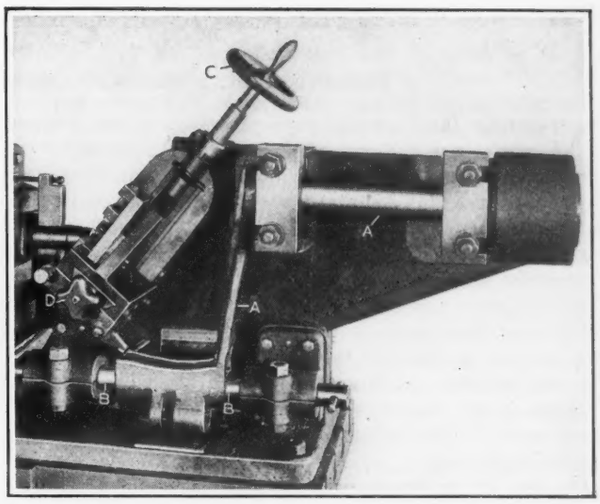


Fig. 2. Detail View of Attachment used for planing a Radial T-slot

* * *

Some interesting information in regard to America's trade relations with British South Africa is given in a recent Commerce Report. It is stated that a large demand already exists in the United States for many of the raw products of South Africa, among which are chrome ore, and with the reopening of more favorable trade conditions it is almost certain that the export of copper, tin, corundum, and asbestos to the United States will increase rapidly. Although the United States has long held a prominent place in the list of countries from which South Africa obtains its manufactured goods, the basis of trade has rested largely upon the gold mining industry, and it is only within recent years that American manufacturers have come to realize the possibility of other means of exchange. The articles of American manufacture for which there is, or might be, a demand in the South African market are numerous, but some of the most important are agricultural machinery, bicycles, bolts and nuts, cranes, elevators, electrical material, fencing wire, locomotives, automobiles, and machine tools.

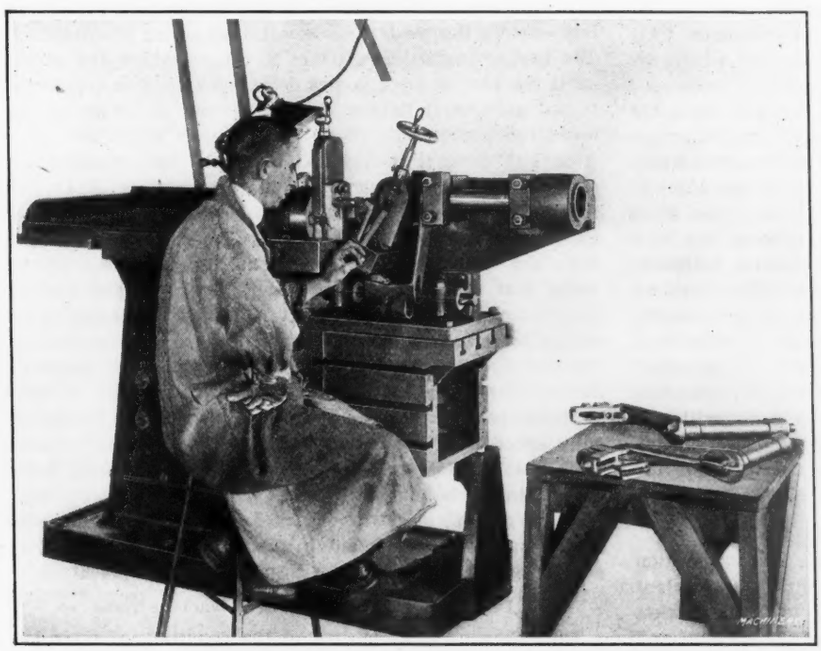


Fig. 1. Radial Attachment applied to a 21-inch Shaper

TREND OF THE MACHINE TOOL MARKET

PRESENT DEMAND—SECOND-HAND MARKET—OUTLOOK IN DIFFERENT LINES

NEARLY three months have passed since the armistice was signed and active measures were adopted for curtailing the manufacture of munitions and the great variety of machine tools and shop equipment required for use in the munition plants. The market for machine tools is naturally governed by the condition of business in those industries which require the products of machine tool building plants for carrying on their work. Consequently, it is of greater importance for the machine tool builder to obtain an accurate forecast of the trend of business in the automobile industry and other lines which are large buyers of machine tools, than it is to learn of actual sales which have been made by manufacturers of lathes, milling machines, boring mills, etc.

In Detroit, rapid progress is being made in readjustment to a normal condition of the automobile industry. The rapidity with which the different builders of passenger cars and motor trucks will be able to get back to regular production depends largely upon how fully their manufacturing capacity was engaged upon special government work at the time the armistice was signed. One of the best-known factories in Detroit had practically its entire plant engaged upon the manufacture of Liberty motors and motor trucks for the Army. Preparation for this work had made it necessary to reorganize departments and install a considerable amount of special machinery. This plant will experience as much difficulty as any in getting back to normal manufacturing conditions; but, despite this fact, it is expected that the normal rate of production will be attained by June 1. Other plants were more fortunately situated and are making more rapid strides toward the complete readjustment of their shop facilities.

Readjustment Creates a Demand for Machine Tools

The changing over of plants to provide for the manufacture of munitions greatly stimulated the demand for machine tools from early in 1915 until the armistice was signed; and it is believed that the readjustment of many of these same industries back to a normal basis, now that the war orders have been filled, will create a new demand for the product of the machine tool builders. It is safe to say that there is no industry, taken as a whole, in which manufacturing facilities have been of a more modern type and more carefully maintained than in the plants building automobiles. But even in these modern factories, there are many tools that have been nearly worn out, or the designs of which are obsolete. Also, the severe service which has been demanded of the mechanical equipment of plants engaged upon the execution of contracts for munitions and military supplies has brought the condition of many machines to a point where they are only fit for the scrap heap. During the interval between intensive war-time production and that time when industry gets back to a normal peace basis, there will be a chance for the management of large industrial plants to carefully scrutinize the condition of their machinery, and replace those machines which are either worn out or obsolete. This practice has created a demand for machine tools from the automobile builders of Detroit; and if these manufacturers, with their modern plant facilities, recognize the necessity of replacing inefficient equipment, the same will naturally be true of those plants where conditions were much less favorable at the time they entered upon work for the Government.

Second-hand Machinery as a Market Factor

There has been some apprehension that, when munition plants throughout the country were dismantled, a sufficient quantity of machine tools would be thrown upon the market to enable the normal demand to be filled by second-hand machinery for some time to come. As a matter of fact, this apprehension seems to have been without foundation. Those who have made a careful study of the subject state that fully 80 per cent of the machine tools sold for use in munition plants were of standard design and could be used for other general classes of machine shop work. But, in order to arrive at an accurate conclusion in regard to how many of these tools are likely to find their way onto the second-hand market, consideration must be given to the conditions under which they have been used. Not only has the character of the service been exceedingly severe, but the machines have also been worked night and day by inexperienced operators. Also, very little time has been spared for making adjustments and repairs, except where they were absolutely necessary. As a result, it is entirely reasonable to assume that there are few machines in the munition plants which will be found in condition for additional service until they have been completely overhauled and practically "remanufactured." Dealers in second-hand machinery state that good machine tools are, at present, very difficult to buy, most of those offered to the dealers being in extremely poor condition and suitable for no other destination than the junk pile. Manufacturers keep their newer types of machines, and are offering only the older ones.

Factors that are Creating a Demand for Machine Tools

Reports received from the important manufacturing centers throughout the country seem to indicate that, in general, both the manufacturers of machine tools and the dealers are experiencing conditions of business which are all that could be expected. Probably there are two vital factors which are responsible for the present demand for machine tools; namely, that worn-out or obsolete machines are being replaced in those factories which are at present switching back from war to peace work, and that there is an accumulated demand for machine tools which has been deferred by government regulations, prohibiting the supplying of machinery for use in non-essential industries.

A factor which is helping to stimulate the present market for machine tools is that sales are being made by some builders for deferred delivery, with the understanding that if the price is reduced before the time delivery is made, the purchaser will be given the benefit of such a reduction. Undeniably, the price of machine tools will fall after the labor and raw material markets have been liquidated; but just how rapidly this result can be attained seems problematical. The cost of materials is likely to remain above the normal until the cost of labor comes down, and labor cannot be obtained at normal figures unless the cost of living is commensurately reduced.

In any case, it is highly improbable that machine tool prices will ever get back to the figures quoted in 1914. During the ten years before the war, the prices of practically all manufactured products, in the making of which machine tools are employed, were substantially advanced, on the claim that the costs of labor and raw materials, and the value of plant investments, had made such increases in the selling price an absolute necessity. The machine tool builder, meanwhile, kept his prices about stationary, because the demand for his product was not sufficiently brisk to make it appear probable that an increase in price could be successfully effected. Then the war-time demand made it possible for him to raise quotations. In some cases, the present prices of machine tools and other shop equipments may seem high, but as a general proposition they do not represent an undue return upon the investment in plant, and the labor and ingenuity which has gone into the design of the machines.

Demand for Various Types of Machine Tools

The following brief outline of the condition of their business, which is reported by builders of various standard types

of machine tools, affords on idea of the demand which exists at the present time: *Automatic Screw Machines*:—Builders of this type of equipment report a good demand for both the machines and product produced on them. A good export demand is also expected to materialize. *Boring Mills*:—Some builders report a fairly good demand, with a fair volume of new orders since January 1; and other builders of this type of machine state that business is quiet at present, but that they anticipate a good demand within three months. *Chucks*:—Business is reported to be very good; there were few cancellations and some shops in this line are still running overtime with a full force. *Drilling Machines*:—Representative builders of drilling machines report that they are receiving plenty of orders, and do not intend to reduce prices unless there is a substantial reduction in the cost of labor; then it might be possible to reduce quotations 10 per cent from the current level. *Gages, Jigs, Fixtures, etc.*:—Business in these lines has naturally fallen off since the armistice was signed. Some shops engaged in making these special tools, however, have found plenty of work for their men in doing contract work for plants that are switching back from government work to their regular line of manufacture. *Grinding Machines*:—There appear to have been comparatively few cancellations of orders for this type of machinery, but, at present, business is slightly below normal. The demand is reported to be increasing possibly as a result of special inducements offered by some builders of grinding machines. *Hacksaw Machines*:—Business is reported as somewhat quiet, although there is a good demand for hacksaw blades. *Milling Machines*:—Business is reported to be good, and builders of this type of machinery anticipate a brisk demand for some time to come. *Small Tools*:—The demand is reported to be fully as good as it was in ordinary peace times. Dealers are out of stock, and this will also create a demand for small tools.

It is generally conceded that the inquiry for machine tools has been steadily improving since January 1. The high prices of materials is one of the serious drawbacks, making it risky for shops to lay in a stock for the requirements of future business. After a period of intense activity during the past four years, many machine tool builders are taking advantage of the present opportunity to overhaul machinery and get their shops into condition for efficiently handling the demand for machine tools which is expected to come when the work of industrial readjustment has proceeded somewhat further. Closing down of the munition plants will return men from these industries to occupations where their labor will result in the production of useful commodities; and this cannot but help to improve business conditions in a way which will be reflected in the machine tool market.

* * *

The American Metric Association, at its annual meeting held in Baltimore, December 27, and at Washington, December 28, was addressed by the Secretary of Commerce, William C. Redfield, who, after outlining his practical experience as a manufacturer for thirty years and his travels in other countries in the interest of the export trade of his own business, voiced the opinion that metric weights and measures should and would be adopted for general use in the United States, stating that he believed that the metric system offered a return to simplicity. An address was also made by Jesse M. Smith, past president of the American Society of Mechanical Engineers, who stated that he had been in close touch with the metric movement for fifty years, and who added that he had frequently used the metric system both in America and in other countries, and believed that it was only a question of time when the metric system would be adopted in all parts of the world. The association indorsed a bill, introduced in Congress by Senator John F. Shafroth, which is intended as a step toward the general use of metric weights and measures, making exceptions where such seem to be advisable for special work.

NEW MATERIAL FOR METAL CUTTING

A new alloy has been developed and patented by H. S. Cooper of Cleveland, Ohio. This alloy is intended mainly for use as a cutting tool for lathes, planers, boring mills, and similar machine tools, but can also be used for milling cutters, hollow mills, chisels, etc. The alloy contains zirconium and tungsten, with nickel as a base. Zirconium is the essential element and gives to the material most of its peculiar qualities. Iron is present in the alloy only as a trace, and is an impurity. Hence, this alloy is not classed as a steel. While it may contain a fractional per cent of carbon, it is not in any way dependent upon carbon for its hardness. The specific gravity of the alloy is lower than that of other alloys used for cutting tools. The material cannot be forged and it requires no heat-treatment. The hardness is varied by changing the proportion of the constituents and it is possible to produce cutting tools having a hardness on the Brinell scale of from 250 to 500 without sacrificing the toughness required to withstand severe usage.

The alloy is quite fluid at a temperature of 1200 degrees C. (2200 degrees F.), which makes it possible to make intricate castings such as milling cutters, gear-cutters, end-mills, etc., as well as the usual bars for lathe tools, requiring only grinding on the surface to produce the finished tool. The molten metal is poured into molds of the required size to give the proper shape.

The material when used either in a lathe, planer, or boring mill, or as a milling cutter, is particularly adapted for high speeds, but heavy roughing cuts with lower speeds may also be taken to advantage. According to the conditions, cutting speeds of from 50 to 300 feet per minute are recommended with feeds varying from 1/32 to ¼ inch. The material will cut at a red heat, which makes it possible to operate it at the high speeds mentioned.

As an example of the performance of the metal, it may be mentioned that in one case a tool ½ by 1 by 10 inches was used to cut a 1.10 per cent carbon tool steel, semi-annealed, having an ultimate tensile strength of 101,500 pounds per square inch and an elastic limit of 60,000 pounds per square inch. This steel was cut at a speed of 85 feet per minute with a feed of 1/32 inch and a depth of cut of 3/16 inch without the use of a lubricant. It is also stated that in a series of tests lasting several weeks, in which time several thousand pounds of the tool steel mentioned above was cut with this alloy, the average time between grindings was forty-nine minutes, while the best 18 per cent grades of high-speed steels of average quality averaged only twelve minutes.

* * *

NATIONAL ASSOCIATION OF ELEVATING TRUCK MANUFACTURERS

The National Association of Elevating Truck Manufacturers has recently been organized, comprising the manufacturers of elevating trucks in the United States. The officers are as follows: President, W. M. Lyman, president and treasurer of the Holyoke Truck Co., Holyoke, Mass.; vice-president, J. W. Grayson, sales manager of the National Scale Co., Chicopee Falls, Mass.; treasurer, A. L. Lewis, president of the Lewis-Shepard Co., Boston, Mass.; secretary, Byron Fields, sales manager, George P. Clark Co., Windsor Locks, Conn. The next meeting of the association will be held next July at Hotel Traymore, Atlantic City, N. J.

* * *

CORRECTION

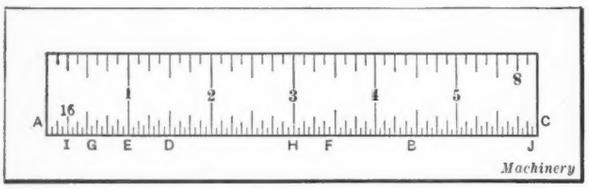
In the article entitled "Making Electric Steel for Roller Bearings," which appeared in the December number of MACHINERY, a statement was made that the manipulator which serves the hydraulic press shown in Figs. 10 and 11 was built by the Morgan Engineering Co. of Alliance, Ohio. This statement was made in error, as the manipulator shown was built by the Alliance Machine Co. of Alliance, Ohio.

SETTING CALIPERS AND DIVIDERS ON THE STEEL RULE

BY C. C. HERMANN

The writer has noticed that some machinists have considerable difficulty in setting calipers and dividers by means of the steel rule. They do not seem to use any definite method of setting, so that much time is wasted in selecting the graduations to be used. The fault may be due to the fact that they have never been taught a good method. Many mistakes may be traced directly to the inaccurate setting of these instruments. A pair of calipers or dividers will determine if the piece of work is correct to the setting of the tool, but this fact does not insure the correctness of the work to some predetermined dimension, unless the calipers or dividers have been accurately set. In other words, the calipers or dividers are only a means of transfering a certain dimension from a standard gage to the work, so if the instrument is incorrectly set the work will be wrong. The methods given here will be found both simple and accurate.

The rule commonly used by machinists is a six-inch steel rule which is generally graduated on one side into eighths and sixteenths of an inch and on the other side into thirty-seconds and sixty-fourths. The graduations are marked 8, 16, 32, and 64 near the end of the respective series. The whole inch divisions are numbered from 1 to 6, starting from the left-hand end, the number 6 being left off as it falls on the edge of the rule.



Machinist's Six-inch Rule

Setting the Calipers

Suppose that a pair of calipers is to be set to measure 4 7/16 inches. Place one leg against the left-hand end *A* of the rule and in line with the graduations marked 16. Then move the other leg until it is past the seventh division to the right of the 4-inch mark, or to the letter *B*. Many machinists prefer to start from the right-hand end of the rule. To use this method, place one leg of the calipers against the right-hand end *C* of the rule and move the other leg until it has passed over four whole inch divisions and seven small divisions, or to the point *D*. When using this method no attention is paid to the figures denoting the whole inch divisions, as the correct setting of the rule is found by subtraction. For example, as the rule is six inches long, 4 7/16 inches is 6–4 7/16 = 1 9/16 inch, which is the distance *D* is from the left-hand end *A* of the rule. These methods may be applied to the other graduations of the rule. In all cases the series of graduations corresponding to the fractional part of the dimension should be used to insure accuracy in setting.

Setting the Dividers

When setting the dividers, the best result can be obtained by placing the end of one leg on some division rather than by holding it against the end of the rule. For instance, to set the dividers to 2 7/16 inches, place the end of one leg in the graduation representing the first whole inch division at the left-hand end of the rule, or at *E*. Then count to the right two whole inch divisions and seven small divisions, or to *F*, in which place the end of the other leg. Sometimes, however, it is more convenient to work to the right and left of the whole inch division. Thus starting at the first whole inch division, or 1, count seven small divisions to the left, or to the point *G*, in which place one leg of the dividers. Then count two whole inch divisions to the right, or to the mark *H*, in which place the other leg.

Since the rule is only six inches long, it is not possible to set the dividers to a greater dimension than five inches by resting one leg on a whole inch division. Should it be desired to set the instrument to 5 11/16 inches, for example, a division nearer the left-hand end than the 1-inch mark *E* must be taken for a starting point. The 1/2-inch graduation will not do for 6–1/2 = 5 1/2 inches, which is not sufficient. However, the fourth sixteenth division *I* from the left-hand end or the 1/4-inch graduation will do, because 6–1/4 = 5 3/4 inches, which is the amount lying to the right of this division. Place the end of the dividers in this division *I* and as 6–(1/4 + 5 11/16) = 1/16, place the other leg in the first division from the right-hand end of the rule, or at *J*.

Should it be desired to set a pair of dividers to 3 31/64 inches, the graduations marked 64, on the other side of the scale must be used. Place the end of one leg of the dividers into the 1-inch mark and move the other leg over three whole inches. As 1/2 inch is equal to 32/64 and as the fraction desired is 31/64, move this leg of the dividers to the 1/2-inch mark past the four whole inch division and then back one division. Another way of setting the dividers for this dimension is to count off the fraction to the left of the 1-inch mark and then move the other leg past three whole inch divisions or to the 4-inch mark, thus moving on both sides of a selected division.

* * *

LOOKING AFTER THE HEALTH OF WORKERS

The precautions taken by the Bickett Machine & Mfg. Co., Cincinnati, Ohio, to prevent illness among its employes are well worth noting, as similar plans, if followed in other shops, would doubtless have a remarkable influence upon the health of industrial workers. The Bickett Co. employs a physician and surgeon who is in attendance at the shop daily from 9 to 11 A. M. and has an office in the plant. Considering the fact that the shop employs only about 200 men, the daily presence of a physician is unusual. The men are at liberty to consult this physician without charge, and the effects upon the general health of the employes have been most gratifying.

During the recent influenza epidemic the production of the factory was maintained without any decrease and although 50 per cent of the employes showed first symptoms of the disease not a single case progressed beyond its early stages when the treatments prescribed were followed. At one time there were 57 cases in the first stages of influenza, but of that number only one person was absent from his work and that one only for a couple of days. Not a single serious case developed among a force of 200 men during the entire duration of the epidemic.

In addition to the physician, there is a welfare worker employed at the shop, who interviews the foremen every morning and arranges for any man to consult the physician in case he shows the slightest symptoms of illness. Thus the treatment begins at once and any serious illness is prevented from the start. The welfare worker keeps in personal touch with the men, urging them to follow faithfully the treatment prescribed. The men, noting the beneficent results, are naturally quite anxious to avail themselves of the services of the physician.

The welfare worker, in addition to his endeavors among the men in the plant, extends his work to the domestic life and to the families of the employes. He is a trained social worker and offers helpful advice and cooperation wherever it is needed. Special attention is given to sanitation, and if it is necessary for the welfare of the family, it is recommended that they move to some other locality within the city, assistance being given them in moving in any way that may be required. Personal hygiene is also taught the men, and the endeavors in this direction are paying dividends in the form of good health and increased production.

FLEXIBLE FABRIC UNIVERSAL JOINTS[1]

BY C. A. SCHELL[2]

The development of the flexible fabric type of universal joints, like that of most new industrial products, has been an industrial evolution rather than an abrupt change from one proved construction to another and newer design. This type of joint has been in use on automobiles in this country for about four years, and has given very satisfactory results. Some of the engineers who first experimented with this type of universal joint obtained discouraging results in most cases, owing either to a lack of knowledge of the fabrics and friction material required in the construction of the disks, or, in many cases, to lack of care and thought in the design of the metal parts. In some of the earlier tests it was soon learned that very good fabric must be used and that it must be woven correctly. Disks woven in six directions or sectors, with the strands running completely around the disks gave satisfactory results, but were expensive and involved the necessary installation of intricate machinery. Another construction, that of building up the disks by the straight method, or by laying one ply upon the next, without particular attention to the direction of the weave, was unsatisfactory, and uneven strength and a stretching in the different sectors resulted. In practical use, the sector which happened to be in such relation to the bolt holes as to take the greatest part of the load, failed quickly.

Efficiency of Hardy Type Flexible Fabric Disk

The Hardy disk, which is made by twisting the plys in consecutive fashion so that the disk is uniform in strength, has perhaps proved to be the most satisfactory. This type, when made of a good fabric, has a tensile strength of 3000 pounds per square inch. Disks of other types of construction can and are being used, but the Hardy type seems to provide considerable elasticity, and the cushioning effect of the elastic disks adds greatly to the life of the shafting, bearings, gears, transmission, clutch, and even to the engine. Much trouble was also experienced in some of the earlier clutch assemblies, because of the lack of care in designing the metal parts. Excellent disks may fail if they are not provided with good friction washers. Most of the first washers were made too thin and allowed the fabric to pull out under the surface, throwing the load onto the bolt holes until failure took place. The washers should be made thick enough to resist cupping, and should be knurled like a clutch-pedal, in order to grip the fabric snugly and drive by friction. It is also good practice to groove or knurl the driving side of the spider bosses. It must be remembered that the disks are comparatively soft, that the volume or section held tightly under the washer face is depended upon to do the work, and that a disk made of the most expensive materials will fail unless efficient washers are used.

Use of Flexible Coupling with Hotchkiss Drive

One of the strongest arguments for the use of the Hotchkiss drive is the flexibility of transmission; therefore, with the installation of the flexible coupling in addition, a still greater cushioning effect is obtained. Of course, this cushioning can be obtained even on fixed axles with the coupling, and to a much greater extent than with the Hotchkiss drive itself. The Studebaker Corporation, after experimenting and going thoroughly into the proposition, both in the laboratory and on the road, has adopted the flexible disk as a clutch-to-transmission coupling on all of its new chassis. The engine in the large Studebaker chassis develops a torque of about 2400 inch-pounds, and in this case a single disk, 7½ inches in diameter and 13/32 inch in thickness, consisting of 10 plies of fabric, is used. By actual test this disk will not fail until a torque of from 12,000 to 13,000 inch-pounds has been developed, pulling through 1⅜-inch diameter washers. This complete assembly is lighter than a metal type for the same place. It also requires no attention, eliminates backlash and noise, and adds greatly to the life and safety factor of all metal parts. In the Studebaker disks four-arm spiders are used, and the bolt holes are on a 5⅝-inch radius with 1⅜-inch diameter washers. The disk will carry a 6750-pound load at the bolt-circle radius. The actual load at this distance from the center is equal to 850 pounds; consequently this assembly has a very high factor of safety.

Three- and Four-arm Spiders

Another well balanced design consists of the use of two disks per joint, 6½ inches in diameter and 5/16 inch thick, with a 1¾-inch diameter knurled washer and using three-arm spiders. For engine-to-transmission-case couplings, many designers are now using the four-arm spider, similar to the Studebaker type, taking advantage of the fourth arm for extra strength and thereby saving fabric and making a slightly cheaper assembly, although the flexibility is somewhat decreased. With a three-disk joint, if the hole in the center of the disk is not too large, it will be very strong in a direction outward from the center and will still have flexibility laterally.

Advantage of Using Flexible Coupling between Engine and Transmission

For installation between the engine and transmission, the flexible coupling eliminates all bearings and splines, thereby avoiding the production of noise and doing away with the inconvenience of greasing. In addition, it reduces severe shocks, makes the shifting of gears easier and, owing to these qualities, adds greatly to the life and safety factor of all the metal parts. In laying out propeller shaft joints, many factors besides torsional load are to be considered, the angle of shaft and the amount of lateral movement being the most important. On account of these conditions, the three-arm type is the most practical and is the only one now used between the engine and transmission. The diameter and thickness of the disks are partly dependent on the lateral movement and angularity, and should be great enough to take care of the increased torque while in low gear. Contrary to general opinion, the thrust required to stretch the disks to take care of lateral axle movement is very slight. The variation is taken up in two sets of disks, and if a total of ¾ inch is required, each coupling must move only 3/16 inch either way.

Correct Location of Coupling

Many of the first engineers to experiment with propeller shaft couplings had trouble with vibration. This was often due to poor machine work or to a bad combination of disks. Several light cars with fairly high-speed engines are using rear installations, and when the assembly is properly machined, no trouble of this nature is experienced. Vibration led to the application of centering devices, but on the whole these were not especially successful. When extremely high speeds, together with large shaft angles are encountered, a good centering device will help to minimize the small amount of vibration which may develop. On a chassis which has a low-speed engine and a propeller shaft mounted on about an 8-degree angle, with the car light, it has been found that with the use of a metal joint, the pinion and transmission shafts must be lined up very carefully, in order to obtain a smooth low-speed performance and eliminate the slight jerking of the car. However, with the use of flexible joints which have been properly constructed, it has been possible to place the shafts in a great variety of positions in relation to each other, and still have a smooth action.

A complete shaft assembly with well designed metal parts weighs about 80 per cent as much as a metal joint of similar capacity. It requires no attention, eliminates backlash, adds to the safety factor of the other chassis parts, and acts as a sound insulator between the axle and the frame.

[1]Abstract of a paper read before the Indiana Section of the Society of Automotive Engineers.

[2]Chief Engineer, Thermoid Rubber Co., Trenton, N. J.

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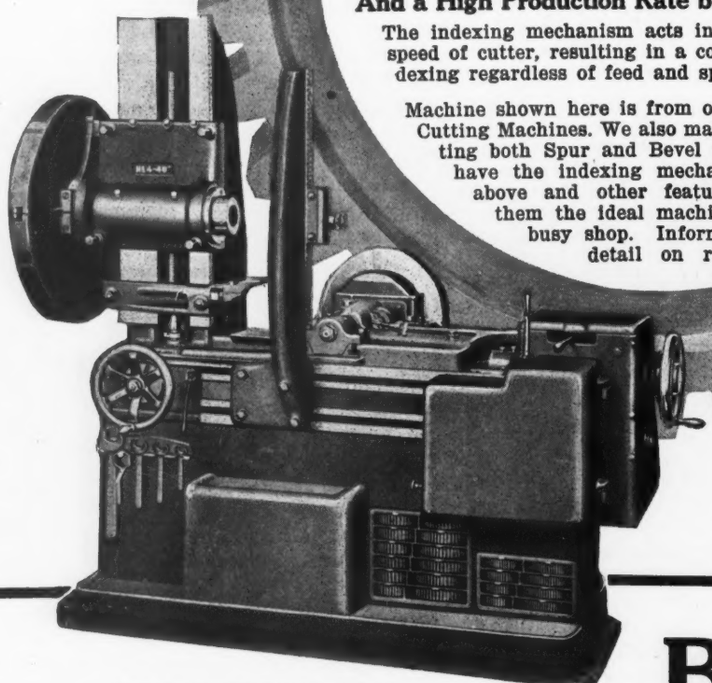

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WILLIAM K. SWIFT has become associated with the Sales Department of the Bound Brook Oil-less Bearing Co., Bound Brook, N. J.

W. P. SPARKS is now connected with the Cleveland Milling Machine Co. as Indianapolis representative, with office at 316 Terminal Bldg., Indianapolis, Ind.

LIEUTENANT J. B. HOWELL has been mustered out of the artillery service and has rejoined the Bound Brook Oil-less Bearing Co., Bound Brook, N. J., in his former capacity.

GRAHAM W. BROGAN, formerly advertising manager of the Duesenberg Motors Corporation, has entered the employ of the Black & Decker Mfg. Co., Baltimore, Md., and will handle the publicity of this company.

LEWIS RUSSELL, who has been manager of the Plant Section New York District, Ordnance Office, has returned to his duties as president of Russell, Holbrook & Henderson, Inc., 30 Church St., New York City.

GEORGE W. FELTON, formerly assistant chief engineer with the New Process Gear Corporation, Syracuse, N. Y., is now factory superintendent with the Crofoot Gear Works, Inc., Cambridge A Station, Boston, Mass.

HERBERT W. GLADHILL, sales engineer in the Philadelphia office of the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., has been made district manager of that office, with Glenn Rumsey and Leland Woodworth as assistants.

S. R. WARNER, who has been in charge of gaging production in the Plant Section, New York City District, Ordnance Office, is now connected with the Sales Department of Russell, Holbrook & Henderson, Inc., 30 Church St., New York City.

L. P. PROSSEN, formerly mechanical superintendent of the Black & White Taxicab Co., New York City, has become associated with the Nilson-Miller Co., Hoboken, N. J., as vice-president, and will have charge of the gear-cutting, piston and piston ring departments.

THOMAS P. ORCHARD, formerly production manager on the Browning machine gun tripods with the New Britain Machine Co., New Britain, Conn., has joined the Service Engineering Co., planning and quantity production specialists, 25 Church St., New York City, as sales engineer.

FREDERICK A. SCHEFFLER is now associated with the Fuller Engineering Co., Allentown, Pa., as manager of the department devoted to the application and introduction of pulverized coal equipment for steam power plants in the United States. Mr. Scheffler will be located at the company's New York office at 50 Church St.

HORACE N. TRUMBULL, who has recently received his discharge from the Engineers Officers' Training School at Camp A. A. Humphreys, Va., has been appointed advertising manager of the Wellman-Seaver-Morgan Co., of Cleveland, Ohio. Before entering the service, Mr. Trumbull was advertising manager with the S K F Ball Bearing Co., of Hartford, Conn.

C. J. BROWN, who has been connected with the Sales Divisions of the R. D. Nuttall Co. for the past three years, has become associated with Frank M. Erb, representing, in the Pittsburg district, the Silver Mfg. Co., National Forge & Tool Co., Horsberg Forge Co., and Meadville Malleable Iron Co. Mr. Brown will be located at 902 Second National Bank Bldg., Pittsburg, Pa.

WILLIAM BLAKE PATTERSON, president of the Patterson Tool & Supply Co., Dayton, Ohio, has been appointed special representative in Italy and Switzerland for the Monarch Machine Tool Co., Sidney, Ohio, manufacturer of lathes, and with his wife and daughter expects to sail for Italy this spring. Mr. Patterson will retain his position and interests in the corporation of which he is president.

E. ERICHSEN, formerly New York manager of the Allied Machinery Co. of America, has joined the Youroveta Home & Foreign Trade Co., Inc., 165 Broadway, New York City as vice-president and manager of the New York office. Mr. Erichsen has had extensive engineering experience in America and Norway, and from 1909 to 1914 was managing director of important stamping and enameling works in Bergen, Norway.

J. ARTHUR DEAKIN, formerly representative in the United States for H. W. Ward & Co., Ltd. of Birmingham, England, has become New York manager of E. Isbecque & Co., 15 Park Row, New York City. E. G. TODD, who has been managing the New York office during the period of the war, is about to return to Europe to resume the direction of the machine tool and small tool departments in the Brussels and Antwerp offices.

L. E. SCHUMACHER, who has been chief inspector of the Westinghouse Electric & Mfg. Co. at East Pittsburg, Pa., for the last eight years, has been promoted to the position of works manager of the Krantz Mfg. Co., Brooklyn, N. Y., the latest subsidiary of the Westinghouse Electric & Mfg. Co. Prior to his coming to the company in June, 1900, Mr. Schumacher was employed at the Niagara Falls Power Co., which at that time was the largest electric water power installation in the world.

D. G. CAYWOOD, formerly sales manager of the Brunner Mfg. Co., Utica, N. Y., has become special representative of the Black & Decker Mfg. Co., Baltimore, Md., maker of portable electric drills and electric air compressors. Mr. Caywood will carry on the field work in the distribution of the Black & Decker specialized products. He has been actively engaged in the electric air compressor field for the last fifteen years. Mr. Caywood's headquarters will be at the Baltimore factory of the Black & Decker Mfg. Co.

STURE OSMAR, vice-president and general manager of G. A. Lindstedt & Co., Stockholm, Sweden, has arrived in the United States with a view to arranging for agencies and connections with leading American manufacturers of machine tools and accessories. His company is one of the best known machine tool dealers in Sweden, the capital of which has recently been increased to Kr. 4,000,000 (about $1,100,000). Several of the most prominent industrial men in Sweden, among whom are the directors of Sandvikens Iron Works and the Billeruds Co., have an active interest in the organization, which represents many Allied business organizations in the Scandinavian countries. Correspondence for Mr. Osmar during his stay in the United States may be addressed in care of the Swedish Gage Co., 245 W. 55th St., New York City.

OBITUARIES

ANDREW G. ANDERSON, president of the Anderson Mfg. Co., Elyria, Ohio, died December 29.

ARTHUR DANIEL GALLMEYER, a member of the firm of the Valley City Machine Works, Grand Rapids, Mich., and superintendent of the foundry department, died November 23.

CHARLES J. MANDLER, president of the Allen Filter Co., Toledo, Ohio, died December 8 after a short illness from influenza and pneumonia, aged forty-four years. Mr. Mandler leaves a wife and daughter.

JOHN B. PALIZZA, secretary and sales manager of the Langelier Mfg. Co., Arlington, R. I., died December 25. Mr. Palizza was born in Montreal in 1885 and spent his early years in that city. He was a graduate of the LaSalle Academy and of the Rhode Island School of Design. After graduating from the latter institution he was employed by the Textile Finishing Machinery Co. of Providence, R. I., and later was consulting engineer for the Knight C. Richmond Co. He had been connected with the Langelier Mfg. Co. for eight years. He is survived by a widow and one child.

ANGUS SINCLAIR, editor and proprietor of *Railway and Locomotive Engineering*, died at his home in Millburn, N. J., January 1, aged seventy-seven years. Mr. Sinclair was born in Scotland, and first entered the British Customs Service, after which he sailed the seas for some time in the engine room of ocean-going vessels, until he finally came to the United States and entered railway work in the Middle West. As a railway engineer he became acquainted with the late George Westinghouse, and wrote one of the earliest descriptions of the air-brake. He also wrote a number of other books and articles relating to locomotive operation. In 1883 he became associate editor of the *American Machinist*, and in 1892, after a varied editorial experience on various trade journals, he went into partnership with the late John A. Hill, and bought *Locomotive Engineering*, and later a controlling interest in the *American Machinist*. In 1897 the partnership was dissolved, and Mr. Sinclair became the sole owner of *Locomotive Engineering*, which he retained until his death, the name later having been broadened to *Railway and Locomotive Engineering*. About ten years ago he received the degree of Doctor of Engineering from Purdue University, and for eight years he was special instructor in the mechanical department of the Erie Railroad. He was also at one time secretary and later treasurer of the American Master Mechanics Association. His wife survives him.

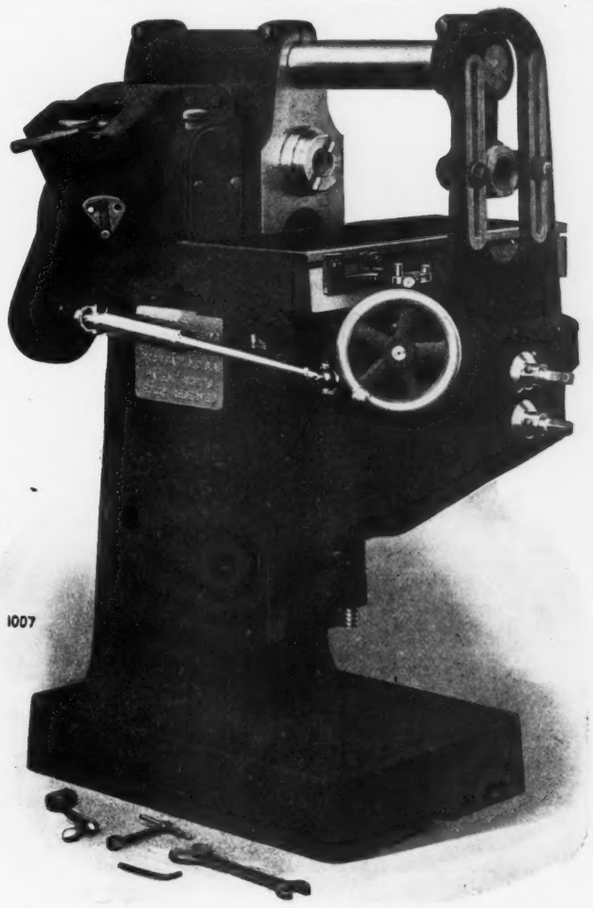
* * *

In view of the scarcity of graphite for industrial purposes, it is of interest to note that the French Government has authorized the Governor-General of Madagascar to permit the immediate export to the United States of 15,000 tons of graphite during the first six months of 1919.

The New Cincinnati 12" Knee Type Manufacturing Miller for Repetition Work.

Also Made with 18" Travel

Shops turning out great quantities of small parts will find this machine intensely profitable. Capable of standing up to the drive of twenty-four hours a day service, and giving maximum production at all times. It is just as profitable as a jobbing machine. It is compact, having only 12" table travel. It is powerful—4 h.p. at the spindle. The drive is by constant speed belt, with a commercial range of feeds and speeds, and for the sake of simplicity, quick change mechanisms have been avoided, the change in feed or speed being made by interposing change gears.



The Cincinnati 12-inch Knee Type Manufacturing Miller
Also made with 18-inch travel
(Patent Rights fully Reserved)
Single Pulley Drive—4 H. P.—Twelve speeds—Four feeds

It Is Handy

The operator stands at the end of the table. Assume that a new piece has been chucked: He runs the table forward with his right hand at 2¾" per turn of the hand wheel. A dog hits the trip, which automatically disengages the hand movement, and at the same time throws in the power feed. When the piece has been milled, another dog disengages the power feed, and the operator brings the table back by hand, ready to chuck a new piece.

This is quick action. The operator can slam the table forward as fast as he pleases without danger of jamming the work into the cutter. The trip dog takes care of that, and it can be set so that the work will be close up to the cutter before the power feed engages, thus reducing the power travel of the work to a minimum.

Ask for complete specifications.

THE CINCINNATI MILLING MACHINE COMPANY

CINCINNATI, OHIO, U. S. A.

SOCIETIES, SCHOOLS AND COLLEGES

Louisiana State University, Baton Rouge, La. Catalogue for 1917-1918 with announcements for 1918-1919.

Lowell Textile School, Lowell, Mass. Bulletin for 1918-1919, giving courses and schedule for evening classes.

Clarkson College of Technology, Potsdam, N. Y. Special commencement bulletin for 1918 containing the names of graduates and information relating to the commencement exercises.

American Museum of Safety, 18 W. 24th St., New York City, has changed its name to the Safety Institute of America. The officers for the coming year are Arthur Williams, president; James Speyer, treasurer; Dr. William J. Moran, secretary. The vice-presidents are E. H. Gary, Mrs. E. H. Harriman, Dr. William H. Nichols, Charles E. Hughes, and B. B. Thayer.

American Society of Mechanical Engineers, 29 W. 39th St., New York City, announces that the Engineering Index, published for twenty-five years by the "Engineering Magazine" and its successor, "Industrial Management," has been acquired by the American Society of Mechanical Engineers, and will hereafter be compiled and published by the society. The first issue of the Index under its new management appears in the January number of the Society's Journal. As heretofore, the Engineering Index will be regularly issued in three different forms: (1) As a part of the Journal of the society. (2) As a separate monthly publication for libraries or individuals desiring to clip the items for indexing purposes. (3) As an annual volume in which all the items for the year are collected. Through the facilities afforded by the library of the Engineering Societies, which receives regularly 1100 periodicals from all parts of the world, the society has unlimited possibilities for publishing the Index. These periodicals comprise one of the most complete collections of current engineering literature in the world, representing not less than ten languages, and are received from thirty-seven different countries.

BOOKS AND PAMPHLETS

Design and Test of Standards of Mass. 89 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Circular No. 3 of the Bureau of Standards.

Annual Report of the Chief of Bureau of Foreign and Domestic Commerce, to the Secretary of Commerce for the Fiscal Year Ended June 30, 1918. 93 pages, 6 by 9 inches. Published by the Department of Commerce, Washington, D. C.

Proceedings of the 26th Annual Convention of the Traveling Engineers' Association. By W. O. Thompson. 478 pages, 6 by 9 inches. Published by the Secretary of the Association, W. O. Thompson, Care of General Offices, New York Central Railroad, Cleveland, Ohio.

Signaling in the United States Navy and Merchant Marine. 47 pages, 3½ by 6½ inches. Published by the Army and Navy Signal Publishers, 8 Beacon St., Boston, Mass.

This booklet is published for use with the United States Navy and Merchant Marine Signal Chart, which is also issued by the same publishers. The book gives complete instructions for the use of the chart.

How Industrial Fatigue May be Reduced. 12 pages, 6 by 9 inches. Published by the United States Public Health Service, Washington, D. C., as Reprint No. 482.

This pamphlet comprises the preliminary report of the Divisional Committee on Industrial Fatigue, Section on Sanitation, National Committee on Welfare Work. It discusses ways of detecting and of reducing fatigue.

Hours of Work as Related to Output and Health of Workers (Wool Manufacturing). 69 pages, 6 by 9 inches. Published by the National Industrial Conference Board, 15 Beacon St., Boston, Mass., as Research Report No. 12.

This pamphlet contains a report which is the result of an investigation made by the National Industrial Conference Board concerning the hours-of-work problem in major industries. This report is the third of a series and relates to the wool manufacturing industries.

Inventor's Manual. By George M. Hopkins and A. A. Hopkins. 144 pages, 5 by 7½ inches. Published by the Norman W. Henley Publishing Co., 2 West 45th St., New York City. Price, $1.25.

This is the second revised and enlarged edition of a book intended to give the inventor and patentee some hints on patents in general, together with approved methods of bringing patents to public notice. The book deals with a great many subjects in connection with inventions, patents, and their commercial exploitation, some of the section headings being as follows: Patent Advertising; Making and Prosecuting Your Own Application; A Limited Patent; Record of Invention; The Development of the Invention; Assignments; Reversion of a Patent; Design Patents; Patents as the Basis of Business; Profits from Inventions; How Patents Promote Trade; Joint Ownership; Partly Expired Patents; Foreign Patents; The Inventor and the Promoter.

American Methods in Foreign Trade. By George C. Vedder. 204 pages, 5½ by 8 inches. Published by the McGraw-Hill Book Co., Inc., 239 W. 39th St., New York City.

This book is intended for the American business executive who is interested in foreign trade methods. It is stated in the preface that American manufacturers are not the best exporters in the world, but the best exporters in the world are American manufacturers, it being intended to convey the idea that while as a whole, American manufacturers have not yet grasped the important principles of foreign trade, some of the most efficient world traders in steel, heavy machinery, cash registers, and numerous other articles are to be found among large American manufacturing enterprises. The book deals with a great number of problems met with in foreign trade; agencies, catalogues, advertising, foreign credits, foreign correspondence, American banking abroad, foreign investments, the American merchant marine, etc.

Graphical and Mechanical Computation. By Joseph Lipka. 264 pages, 6 by 9 inches, 205 illustrations. Published by John Wiley & Sons, Inc., 432 Fourth Avenue, New York City. Price, $4.

This book embodies a course of study prepared by the author, who is assistant professor of mathematics in the Massachusetts Institute of Technology. It is designed as an aid in the solution of a large number of engineering problems of an advanced character. The book is divided into nine chapters headed as follows: Scales and the Slide-rule; Network of Scales; Nomographic or Alignment Charts; Nomographic or Alignment Charts, Continued; Empirical Formulas—Non-periodic Curves; Empirical Formulas—Periodic Curves; Interpolation; Approximate Integration and Differentiation. The work is of an advanced character and can be used to advantage only by students well versed in mathematics and by engineers of an analytical trend of mind. It is mainly intended as an advanced text-book in engineering colleges.

Gasoline and Kerosene Carburetors. By Victor W. Page. 206 pages, 5 by 7½ inches; 89 illustrations. Published by the Norman W. Henley Publishing Co., 2 West 45th St., New York City. Price, $1.50.

This book is intended to provide a simple comprehensive treatise for practical men on the construction, installation, and adjustment of gasoline and kerosene carburetors, explaining the principles pertaining to carburetors for all types of internal combustion engines that operate on liquid fuels. The subject matter has been presented in a non-technical manner, no attempt having been made to consider it from the viewpoint of either the engineer or the scientist, but rather to adapt it to the average mechanic, repairman, and motorist. The book is divided into seven chapters as follows: Liquid Fuel Suitable for Power; Liquid Fuel Supply Methods; Carburetor Action and Construction; Modern Gasoline Carburetors; Kerosene Carburetors; Manifolds and Carburetor Installation; and Carburetor Faults, Location and Remedies. The treatment of the construction of kerosene carburetors of various types is quite complete, and in view of the present possibilities of using kerosene as a fuel, especially in agricultural internal combustion engines, this part of the book should prove of considerable interest and value.

Storing. By H. B. Twyford. 200 pages, 6 by 9 inches; 96 illustrations. Published by D. Van Nostrand Co., 25 Park Place, New York City. Price, $3.50.

This book covers the economical aspect and proper methods used in storing, it being recognized that some of the greatest problems facing large businesses relate to the storing of raw materials and manufactured articles of every kind. The book points out that storekeeping is a function of the management which is often neglected, although it is as important a function as that of actual manufacturing, because everything held in storage is a form of wealth, otherwise there would be no logical reason for storing it. It is further pointed out that the material should be so stored that it is easily accessible, that it does not deteriorate, and that it is not lost. The work is divided into twelve chapters headed as follows: General Considerations; Economic Questions Connected with Storing; Economic Questions Connected with Storing, Continued; Specifications, Definitions, and Standardization; Location and Equipment of Store-room; Appliances for Use in the Store-room; Manual Operations; Clerical Work—Inventories; The Stores Department; Receiving Material; Inspecting and Placing Material in Store-room; and Deliveries from Store-room. There are numerous charts and forms throughout the work, as well as halftone illustrations showing methods of storing and of conveying goods to and from store-rooms. Storing equipment is also thoroughly dealt with, and the book should be of value to every manufacturing concern of such a size that the storing problem requires proper attention by the management.

NEW CATALOGUES AND CIRCULARS

Unity Mfg. Co., Cleveland, Ohio Circular giving sizes and prices of the "E-Z-Set" boring tool.

Buckeye Machine Co., Lima, Ohio. Catalogue of Buckeye Barrett oil engines for operating on low-grade fuel oil.

Aluminum Castings Co., Cleveland, Ohio. Circular relating to "Lynux" bronzes used for bearings and bushings.

Lehmann Machine Co., 608 S. Broadway, St. Louis, Mo. Circular illustrating and describing a taper attachment for use on Lehmann lathes.

Hart-Parr Co., Charles City, Iowa. Instruction book and repair price list, covering the new Hart-Parr oil-cooled gas tractor for general farm work.

Blanchard Machine Co., 64 State St., Cambridge, Mass. Circular illustrating and describing the Blanchard No. 10 high-power vertical surface grinder.

National Tube Co., Frick Bldg., Pittsburg, Pa. Circulars entitled "The Answer" and "The Chief Consideration," advertising National pipe and tubing.

Simonds Mfg. Co., Fitchburg, Mass. Calendar for 1919, each sheet of which contains the calendar for three months and a view of Simonds saw steel products.

Sanitary Appliance Co., 39 Cortlandt St., New York City. Circulars advertising automatic extension reel for electric lamps, and the Barr adjustable window ventilator and draft deflector.

Davis & Thompson, 803 Security Bldg., Milwaukee, Wis. Bulletin 25, containing illustrations and descriptive matter of the Davis duplex milling machine, which is known as the "Rapid No. 3."

Smith-Serrell Co., Inc., 144 Cedar St., New York City. Bulletin 102, giving sizes and list prices of "Pintite" rigid couplings for lineshafting, which can be quickly installed by means of a hammer.

Kelly Reamer Co., Cleveland, Ohio. Catalogue J, of Kelly floating reamers and production tools with adjustable and replaceable high-speed steel blades for machining steel, iron, bronze, or aluminum.

Link-Belt Co., Chicago, Ill. Book 333, entitled "Link-Belt Equipment for the Handling and Preparation of Coal at the Mine," illustrating coal tipples, conveyors, washeries, and other Link-Belt equipment for use in mines.

National Machinery Co., Tiffin, Ohio. National Forging Machine Talk No. 33, treating of the sliding die in the forging machine, and its use. The feature of slide alignment has been given special attention in the National heavy-pattern forging machine.

Union Switch & Signal Co., Swissvale, Pa. Catalogue illustrating the forge department of this concern and its products, among which are airplane forgings, automobile truck and tractor forgings, gear blanks, general forgings and miscellaneous forgings.

Gustave Lidseen, 224-230 N. Desplaines St., Chicago, Ill. Circular descriptive of a new type of positive force-feed oil-can in which the oil is forced out of the can by operating a trigger, instead of pressing a spring bottom, as in the ordinary type of oil-can.

Walter A. Zelnicker Supply Co., 825 Locust St., St. Louis, Mo. Bulletin 250, giving data on new and second-hand rails, locomotives, cars, cranes, shovels, pipe, machinery, tanks, power plant equipment, machine tools, wire rope, hoists, contractors' equipment, etc., carried by this company.

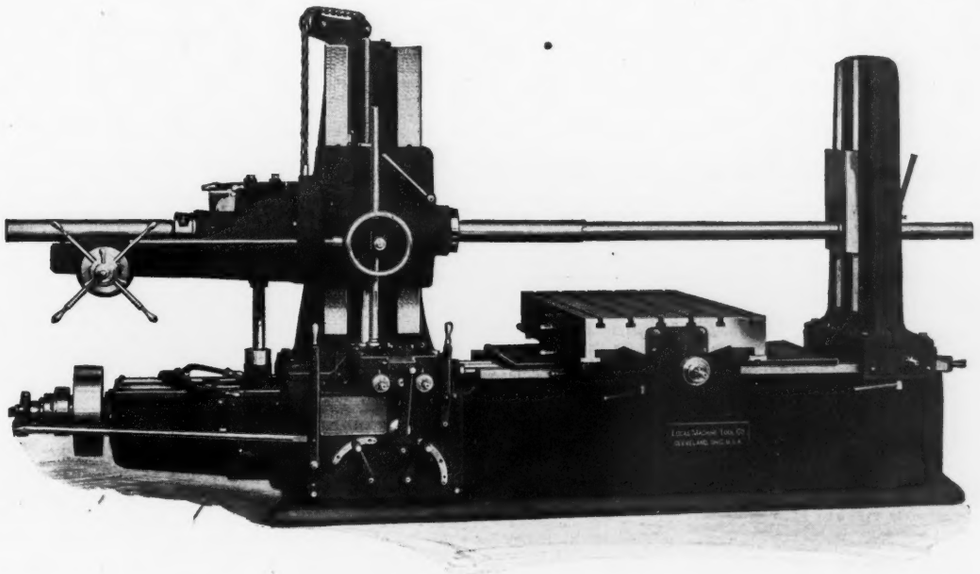
Electric Controller & Mfg. Co., Cleveland, Ohio. Circular describing the E. C. & M. automatic compensator, which is used to start squirrel cage induction motors by first applying a reduced voltage to the motor and then automatically connecting the motor to the line when it has reached the right speed.

Coats Machine Tool Co., Inc., 30 Church St., New York City. Bulletin entitled "The Prestometer for Tool-room and Production Inspection," describing the "Prestometer," a fluid gage for measuring the accuracy of work. A large number of illustrations show the "Prestometer" testing a variety of work.

Advance Tool Co., Cincinnati, Ohio, is issuing a monthly stock list. The January number gives dimensions and other data for counterbores, keyseat cutters, T-slot cutters, side milling cutters, end-mills, angular cutters, hollow-mills, gages, mandrels, reamers, steel sleeves, collets, collet chucks, and keyseat chucks.

Philadelphia Gear Works, 1120-1128 Vine St., Philadelphia, Pa. Catalogue and price list of gears and sprockets, illustrating and describing the different types of gearing cut by the company, giving stock lists of gears and sprockets, and including other information that may be useful to gear users and buyers.

Hilliard Clutch & Machinery Co., Elmira, N. Y. Circular describing and illustrating the construction of the Hilliard multiple disk truck and tractor clutches, a new design of heavy-duty clutches for use with motors rated from 30 to 200 horsepower at 1000 revolution per minute. It is claimed that these clutches will meet the most severe demands of heavy trucks, tractors and gasoline locomotives.



"The open eye of the open mind" needs no glass to see that the

"PRECISION"

Boring, Drilling and Milling Machine

Is the nearest approximation to perfection in the selection of details important in machine design.

These details are given as far as possible in a circular which we would like you to send for.

LUCAS MACHINE TOOL COMPANY

NOW AND ALWAYS OF

CLEVELAND, OHIO, U. S. A.

Sellew Machine Tool Co., Pawtucket, R. I. Circular illustrating and describing the Sellew 16-inch crank-shaper, which is a new product of the company. This machine is primarily a tool-room machine, designed with a view to accuracy in performing its work and convenience of adjustment and operation. The circular gives a complete description of the machine, which is also well illustrated by halftone engravings.

Greenfield Tap & Die Corporation, Greenfield, Mass. Catalogue 40, devoted to the small tools manufactured by this company, which include taps and dies, screw-plates, and reamers. The catalogue gives dimensions and price lists for the various sizes of tools and includes a number of useful tables containing data on threads, tap drill sizes, etc. A pocket edition of this catalogue will be supplied to jobbers and dealers for distribution to the trade.

Barrett-Gravens Co., Transportation Building, Chicago, Ill. Catalogue entitled "How to Save Handling Expense in Factory, Warehouse, and Stock-room," describing the Barrett system of handling materials and pointing out the economies that can be effected through its use. The book contains numerous illustrations showing Barrett lift-trucks in use in various plants. The four models in which the Barrett lift-truck is made are illustrated and specifications are given for each. These trucks are built in two capacities, for handling 2000 and 3000 pounds, respectively.

Edward R. Ladew Co., Inc., 54 Franklin St., New York City. Catalogue treating of Ladew leather belting. The first part of the book contains a discussion of belt engineering and belting economics, taking up efficiency in belting, cost of belt transmission, and life of leather belting. This general discussion is followed by a complete description of the process of making the Ladew leather belting, beginning with the hide and carrying it through the various operations that are necessary to convert it into finished belting. The book also contains rules for users of belts, and tables giving belt travel, horsepower transmitted, and other data relating to belting.

TRADE NOTES

Victor Tool & Supply Co., Detroit, Mich., is buying drills, cutters, etc., from munition plants and refinishing or salvaging them.

Fansteel Products Co., Inc., North Chicago, Ill., has moved its New York office to 15 Park Row, Park Row Bldg., New York City.

McCrosky Reamer Co., Meadville, Pa., has changed its name to McCrosky Tool Corporation. No change has been made in the management or personnel.

Hoefer Mfg. Co., Freeport, E. S., Ill., has broken ground for an addition to its plant. The work including the remodeling of the old plant, is being handled by Frank D. Chase, Inc., industrial engineers, Chicago, Ill.

Wellman-Seaver-Morgan Co., Cleveland, Ohio, has opened an office at 415-417 Rialto Bldg., San Francisco, Cal., in charge of Norman S. Ross. Business from California, part of Nevada, lower California and part of Oregon will be taken care of by Mr. Ross.

Peninsular Machinery Co., machinery dealer, has moved its offices and wareroom to larger quarters at 279-281 E. Jefferson Ave., Detroit, Mich. The increased floor space will enable the company to carry a larger line of machine tools than it has carried in the past.

W. F. Meyers Gage Co., Bedford, Ind., manufacturer of special machines, precision instruments, tools, dies, gages, jigs, and fixtures, has opened an office in the Dime Bank Bldg., Detroit, Mich., which is in charge of L. E. Simon, who will cover the Michigan and Ohio territory.

Michigan Pattern & Machine Works, Detroit, Mich., announces that it has doubled the capacity of its plant to meet the increased demands of the automobile business, and that it is now in a position to handle anything in the jobbing line such as tools, gages, and special machinery.

Electric Furnace Co., Alliance, Ohio, has recently closed a contract with the Standard Roller Bearing Co., Philadelphia, Pa., for a 100-kilowatt continuous automatic heat-treating equipment, consisting of one 150-kilowatt electric furnace for hardening, one 40-kilowatt electric-heated oil drawing bath, and an oil quenching bath.

International Oxygen Co. has removed its general offices from 115 Broadway, New York City, to the company's Waverly Works at 796 Frelinghuysen Ave., Newark, N. J. This centralization of the executive, sales, and production departments has been made in order to serve the interests of the company's trade more effectively.

Electric Furnace Co., Alliance, Ohio, maker of electric furnaces, has just closed a contract with the Braeburn Steel Co., Braeburn, Pa., for a large continuous recuperative annealing furnace, for the annealing of alloy steel bars and wire. The furnace has a capacity for annealing 75 tons of steel per day and an electrical capacity of 600 kilowatts.

Union Switch & Signal Co., Swissvale, Pa., has recently completed a large government contract for airplane engines, and contemplates using the facilities, organization, and experience thus gained in the manufacture of high-grade engines for passenger car and truck service. The company's new five-story buildings are of fireproof construction, and have ample capacity for quantity production.

W. C. Ducomb, Jr., Detroit, Mich., distributor of S K F ball bearing hangers, loose pulleys and friction clutches, belting, belt fasteners, electric motors and sand-blasting machinery, as well as a number of other products, has removed from the Kerr Bldg., and now occupies the entire second floor of 279-281 E. Jefferson Ave., Detroit, Mich., where both sales rooms and stock-rooms are located.

Conlon Electric Washer Co., manufacturer of Western Electric washing machines and other electric household devices distributed by the Western Electric Co., has broken ground at 52nd Ave. and W. 19th St., Cicero, Ill., for the erection of a factory, the cost of which will be approximately $250,000. Frank D. Chase, Inc., People's Gas Bldg., Chicago, Ill., are the engineers in charge of the work.

Frank H. Lee Co., Danbury, Conn., (Machinery Division) has acquired the well-known Walters planer, which until recently has been made at Bridgeport, Conn. This makes another addition to the numerous industries that have recently been brought to Danbury, directly or indirectly, by the Danbury Industrial Corporation, which is a new association formed by the manufacturers and people of Danbury to further the interests of that town.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has moved its plant at Shadyside, Pittsburg, Pa., which has been devoted to the making of electrical equipment for automobiles, to Newark, N. J. Besides a number of accessories, the company is manufacturing lighting apparatus, an ignition system, a self-starting device, and a generator and storage battery to supply power for the foregoing. These generator sets, in addition to being used on automobiles, are also used on airplanes and tractors.

Buffalo Forge Co., Buffalo, N. Y., held a convention of its salesmen in Buffalo, December 11 to 13. This was the beginning of a series of conventions which will be held at more or less regular intervals for the purpose of developing a better understanding among the men. Among the various subjects that were discussed at the convention were Cancellations; Advertising; Meeting Competition; Selling to Engineers, Architects, etc.; Air Washers; Humidity Controls; and various other matters of interest.

Wheelock, Lovejoy & Co. announce that their business has been taken over by Wheelock, Lovejoy & Co., Inc., of Cambridge, Mass. The officers are as follows: President, Harry F. Stimpson; vice-president, A. Oram Fulton; treasurer, Frederick B. Lovejoy. The sales agency agreement heretofore existing with the Firth-Sterling Steel Co., terminated in December, and Wheelock, Lovejoy & Co., Inc., has been appointed by the Ludlum Steel Co. of Watervliet, N. Y., as its general sales agent for the New England states.

Vanadium-Alloys Steel Co., Pittsburg, Pa., manufacturer of high-speed and alloy tool steels, has leased offices and warerooms at 566-568 W. Randolph St., Chicago, Ill. The company will carry in its new warerooms a large stock of "Red Cut Superior" high-speed steel in all the standard sizes and shapes of bar stock, as well as treated bits for tool-holders. The increased facilities will enable the company to carry a much larger stock than formerly with which to serve its customers in Chicago and the surrounding territory.

Walworth Mfg. Co., Boston, Mass., has recently purchased the business of Hunter & Dickson Co., 241-247 Arch St., Philadelphia, Pa., and will operate it as one of the branches of the company. The purchase of the Kewanee Works of the National Tube Co. in 1917 by the Walworth Mfg. Co. so increased its production of valves and fittings for steam, water, and gas work, that the company is well prepared to take care of the growing trade that will come with the rapid expansion of post-war activities in the Philadelphia section.

Onondaga Steel Co., Inc., Syracuse, N. Y., conserver of high-speed steel scrap, has recently purchased twelve acres of land at Eastwood on the outskirts of Syracuse for the purpose of expanding its plant. The new location has excellent shipping facilities. A rolling mill and hammer shop are in operation and a melting shop is finished, melting furnaces now being rapidly installed. Several additional buildings are planned for the near future, and it is expected that the entire plant will be removed from its original location in Syracuse by early spring.

American Pipe Bending Machine Co., 39 Pearl St., Boston, Mass., is about to open pipe bending plants in all the large cities throughout the country. The first plant is practically ready for operation at Lowell, Mass. "Wonder" pipe benders, manufactured by this company, will be used in all the plants. The company will make a specialty of furnishing bent pipe, and will make delivery of small orders at forty-eight hours' notice. Each plant will have facilities for turning out from 1000 to 3000 bends per day. The company is about to be reorganized with a capital of $1,000,000 to carry on this business.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., announces that the Westinghouse Works at Essington, South Philadelphia, Pa., which are now making only ship propulsion machinery, contemplate bringing to Essington all of the turbine and electric generator construction work that is now handled at East Pittsburg. Before this work can be accommodated, however, several new buildings, including an office building and a shop for making turbine blades, as well as an electric generator shop must be built. It is believed that this new construction will begin this spring. Later, it is planned to build electric locomotives at this plant in cooperation with the Baldwin Locomotive Works.

New Process Gear Corporation, Syracuse, N. Y., has been purchased outright by John N. Willys, who has taken over all of the $3,000,000 capital stock of the concern. No change is contemplated in the nature of the product, although it is expected that material expansions in the old field will result. It is the intention of the company to solicit gear business of all kinds, particularly in as far as the manufacture of gears relates to differentials and transmissions for the automobile trade. Thomas W. Meachem and other members of the Meachem family connected with the corporation have retired. No change of active management will be made, immediate control of the enterprise being in the hands of J. Allen Smith.

Tool Manufacturers' Association, Dayton, Ohio, has been incorporated under the laws of the state of Ohio with a charter membership of thirty manufacturers. The following officers were elected: O. Garrison of the Garrison Machine Works, president; J. S. Kepler of the Automatic Machine Co., vice-president; E. F. Moore of the Moore-Eastwood Mfg. Co., treasurer. These officers, together with W. H. McBarron of the McBarron-Mitchell Tool & Mfg. Co. and Lee A. Jones of the Vulcan Tool Co. constitute the Board of Directors. Charles W. Saffell has been employed as secretary of the association, and will maintain an office at 1200 U. B. Bldg. The purpose of the association is to maintain the present standard of efficiency of the industry in Dayton and to inform the trade of the large resources that are available in the tool industry in that city.

Consolidated Steel Corporation, City Investing Bldg., New York City, an organization formed by the independent steel manufacturers to handle their export trade, has been incorporated in the state of Delaware with a capital of $10,000,000. The organization will be the exclusive agency for exporting the merchant iron and steel products of the following companies: Bethlehem Steel Co., Brier Hill Steel Co., Cambria Steel Co., Lackawanna Steel Co., Republic Iron & Steel Co., Sharon Steel Hoop Co., the Trumbull Steel Co., Whitaker-Glessner Co., and the Youngstown Sheet & Tube Co. The president of the organization is E. A. S. Clarke, formerly president of the Lackawanna Steel Co.; the vice-president is H. H. Barbour; secretary and comptroller, L. W. Hesselman; and treasurer, A. Van Winkle. Foreign offices are to be opened and representatives appointed to cover every part of the world where American iron and steel products are usable.

American Bosch Magneto Corporation, 223-225 W. 46th St., New York City, successor to the Bosch Magneto Co., announces that the former German-owned concern is now a 100 per cent American organization, the Alien Property Custodian of the United States having, on December 7, 1918, sold the entire property holdings, assets, and patent rights of the old company to the American Bosch Magneto Corporation. The officers of the new company are A. T. Murray, president; George A. MacDonald, vice-president and treasurer; A. H. D. Altree and Leon W. Rosenthal, vice-presidents; and J. A. MacMartin, secretary and assistant treasurer. The new corporation has taken over the great Bosch works at Springfield, Mass., comprising 250,000 square feet in buildings and having 1500 employes; the complete service and selling system throughout the United States; and the entire ownership of all the United States and foreign patents and trademarks under which the old company operated. It is planned to greatly extend the scope of manufacture in the field of the automotive industries.

National Sales Engineering Corporation, Detroit, Mich., has been organized for the purpose of selling and distributing production tools to the metal-working industries in the Michigan, Ohio, and Indiana territory. The company has been appointed exclusive sales representative for Michigan for the Kelly Reamer Co., manufacturer of adjustable reamers and boring-bars, and for the Buhr-Buiwitt Co., distributor of air equipment. The National Sales Engineering Corporation is also distributor for the product known as the "Universal" drill jig, which is a jig that can be used for all styles of drilling, and will handle the McCrosky Reamer Co.'s lines and the products of the Nelson-Blanck Mfg. Co. E. E. Minard, president and general manager, has been associated with several large concerns throughout the Middle West in an engineering capacity, and has had considerable experience in the sale of production tools in this territory; C. H. Eckhard, vice-president, is known in the Buffalo territory as an expert on air equipment; and T. J. Fraser, secretary and treasurer, has been associated with the small tool industry for several years.